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Forest Statistics for Michigan's Southern Lower Peninsula Unit, 1993

Thomas L. Schmidt

This report includes the most commonly used U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) statistics. Additional forest resource data can be provided to interested users. Persons requesting additional information from the raw inventory data are expected to pay the retrieval costs. These costs range from less than $100 for a relatively simple request to more than $2,000 for a complex retrieval involving the services of a Forest Inventory and Analysis computer programmer. Requests will be filled so as to minimize the impact on the Forest Inventory and Analysis Work Unit.

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FOREWORD

Forest Inventory and Analysis (FIA) is a continuing endeavor as mandated by the Renewable Resources Research Act of 1978. Prior inventories were mandated by the McSweeney-McNary Forest Research Act of 1928. The objective of FIA is to periodically inventory the Nation's forest land to determine its extent, condition, and volume of timber, growth, and removals. Up-to-date resource information is essential to frame forest policies and programs. USDA Forest Service regional experiment stations are responsible for conducting these inventories and publishing summary reports for individual States. The North Central Forest Experiment Station is responsible for forest inventory and analysis in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.

Fieldwork for the fifth forest inventory of Michigan's Southern Lower Peninsula Unit was begun in September of 1992 and completed in August of 1993. Reports of the four previous inventories of Michigan's timber resource are dated 1935, 1955, 1966, and 1980.

To aid in determining current timber removals, the Michigan Department of Natural Resources (MiDNR) surveyed primary wood-using plants in the State. Aerial photographs used were black and white, infrared taken in 1986 at a scale of 1:15,840 (nominal). These photographs were purchased by MiDNR and loaned to the USDA Forest Service.

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HIGHLIGHTS

NOTE: *Data from new forest inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for the comparisons to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve the inventory's efficiency and reliability, we have made several changes in procedures and definitions since the last Michigan inventory in 1980. Because some of these changes make it inappropriate to directly compare the 1993 data with those published for 1980, data from the 1980 inventory have been re-processed using the current procedures. Forest inventories completed before 1980 have not been adjusted to reflect current FIA inventory methodology and techniques. Comparisons between inventories should be general and used solely for analyzing trends.*

All area and volume data and tables were based on what existed as of January 1, 1993, in the Southern Lower Peninsula of Michigan. The time period used for growth, mortality, and removals was January 1, 1980, to December 31, 1992. The area of census water recorded for this unit increased from 198,400 acres in 1980 to 4,603,400 acres in 1993 as major portions of the Great Lakes were allocated to the total area for this unit by the U.S. Bureau of the Census. ***The data in this report are subject to change when inventory data for the entire State have been compiled. It is expected, however, that any such changes will be minor.***

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General

Michigan's Southern Lower Peninsula Unit (fig. 1) is comprised of 35 counties and is the most heavily populated unit in the State. The region is bounded by Lake Michigan, Lake Huron, and Lake Erie, which provide international access for a multitude of products from this region, including a wide array of forest based products.

Agriculture and urban/industrial development dominate land-use and economic activity in southern Michigan. However, forest land represented 21 percent of all land in the Survey Unit in 1993, and provided economic, ecological, scenic, and recreational diversity for the region.

As with most forest land in this region of the United States, the forests in the Southern Lower Peninsula were subjected to intensive harvesting during early European settlement. In addition, widespread slash burning and wildfire, unleashed because of the lack of adequate fire control, contributed to the understocking and poor condition of most of the forest lands by the turn of the 19th century. However, that trend reversed during the early 1900's as regrowth of the forest resource began, in conjunction with organized wildfire control and active forest management. From 1935 through 1955, most of the regenerated forest reached sapling to poletimber sizes (Chase and Pfeifer 1970). These trees have continued to grow into larger diameter classes. Now, the current forest resource is well stocked with a wide range of diameter classes. The following are a few major highlights from the 1993 inventory of the Southern Lower Peninsula Survey Unit.

Figure 1.—*Southern Lower Peninsula Survey Unit, 1993.*

Area

- Forest land accounted for more than 3,053,700 acres in 1993, 21 percent of the total land area (excluding water). Of this total, timberland occupied 3,000,700 acres, and reserved forest land occupied 53,000 acres.

- Timberland increased in area by 20 percent, adding more than 524,000 acres from 1980 to 1993. This represents an average increase of 40,000 acres each year. Most of the increase came from abandoned cropland and pasture on which trees became established through either planting or natural succession between 1980 and 1993.

- In 1993, the 3 million acres of timberland represented the highest level of total timberland area since forest inventories began in this Survey Unit (fig. 2). This increase occurred as new forest stands were established on land previously used in other ways, while existing stands continued to grow and move into the larger stand-size classes.

- More than 738,000 acres of land were classed as nonforest with trees in 1993, an increase of more than 570,000 acres since 1980. These lands have the potential to become forest land if the existing trees are allowed to grow, and if additional tree invasion occurs.

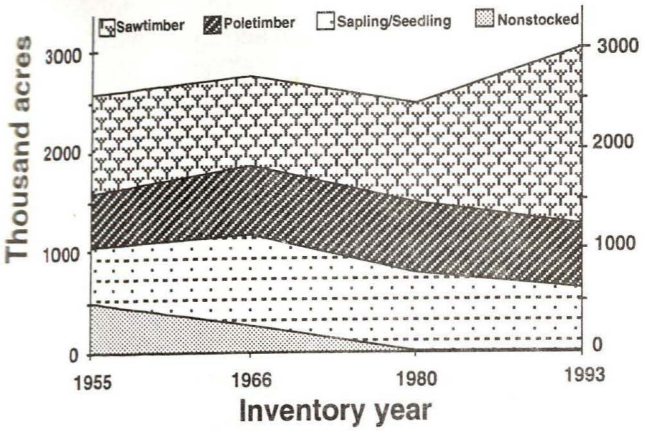

Figure 2.—*Timberland area by stand-size class from forest inventories of the Southern Lower Peninsula in 1955, 1966, 1980, and 1993.*

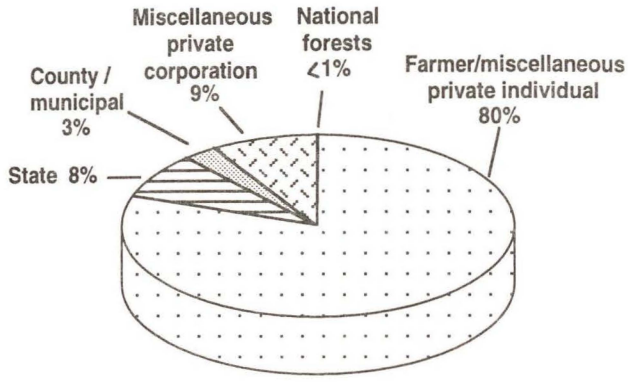

Figure 3.—*Ownership of timberland in the Southern Lower Peninsula in 1993.*

- Area of wooded strips decreased between inventories. In 1980, there were more than 183,000 acres in wooded strips compared to 110,000 acres in 1993. About half of this decline was due to reclassification of some wooded strips that had expanded to more than 120 feet in width, putting them into the forest land category. The other half of the decline was due to the removal of other wooded strips. Where the decline occurred due to physical removal, it represents an important loss because wooded strips provide: water quality improvement by filtering sediments and other pollutants; shading for rivers and streams, which helps to lower the water temperature and improves fish habitat; wildlife habitat and escape cover; soil erosion protection; and aesthetics.

- As in 1980, the group that owned the largest area of timberland was the farmer/miscellaneous private individuals group, with 2.4 million acres in 1993. Miscellaneous private corporations were the second largest owner group in 1993, accounting for almost 260 thousand acres. In 1993, about 89 percent of all timberland in the Unit was privately owned (fig. 3).

- The largest public timberland owner in 1993 was the State, which added substantially to its timberland ownership between inventories, increasing from 150,000 acres in 1980 to 238,000 acres in 1993. In 1993, the State of Michigan owned timberland in 22 of the 35 counties in this Survey Unit.

- Maple-birch was the dominant forest type with more than 1.3 million acres in 1993. The oak-hickory and elm-ash-soft maple forest types were second and third, respectively. These three forest types accounted for 90 percent of the total area of timberland in 1993 (fig. 4).

- All hardwood forest types except aspen increased in area of timberland between 1980 and 1993 (fig. 4). Aspen declined by one-third in timberland area, falling from 181 thousand acres in 1980 to 121 thousand acres by 1993. The loss of aspen was probably due to succession as the intolerant shorter lived aspen succumbed to old age and was replaced by longer lived, shade tolerant hardwoods that had been present in the understory of undisturbed stands.

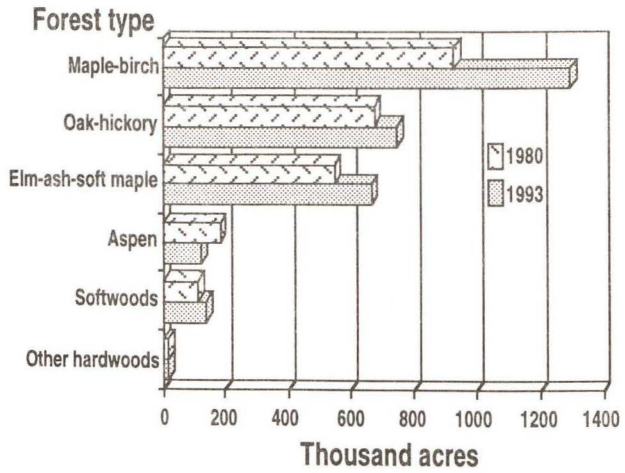

Figure 4.—*Area of timberland by forest types, Southern Lower Peninsula, 1993.*

- Area of nonstocked timberland has steadily decreased from a high of almost 20 percent of all timberland in 1955 to less than 1 percent in 1993 (fig. 2). From 1955 through 1993, the area of poletimber-sized stands remained relatively stable. The major gains in area of timberland by stand-size class since 1955 have occurred with the sawtimber-size class. By 1993, sawtimber stands accounted for 58 percent of all timberland. Poletimber and sapling/seedling stands represented 22 percent and 20 percent, respectively, of all timberland.

Volume

- Total volume of growing stock increased from 2.6 billion cubic feet in 1980 to 4.2 billion in 1993, an increase of more than 60 percent between inventories. Growing stock increased an average of more than 126 million cubic feet each year.

- The hard hardwood species group accounted for 50 percent of the total growing-stock volume in 1993, with more than 2.1 billion cubic feet. Soft hardwoods contributed an additional 1.8 billion cubic feet, 44 percent of the total growing-stock volume in 1993 (fig. 5).

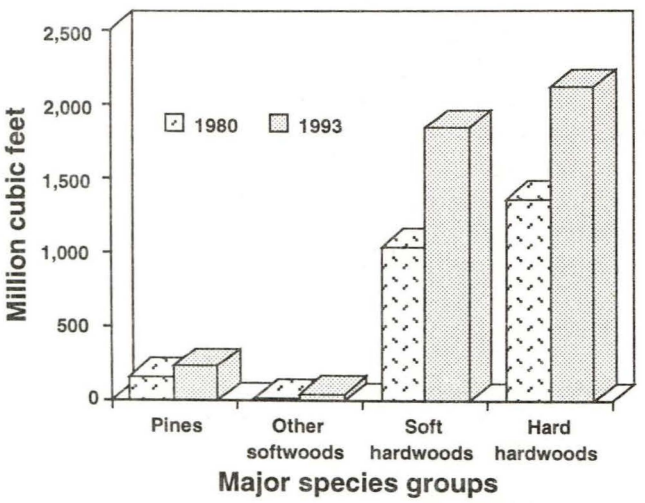

Figure 5.—*Growing-stock volume for major species groups in the Southern Lower Peninsula, 1980 and 1993.*

- Most forest types increased in growing-stock volume between 1980 and 1993 (fig. 6). The greatest increase occurred in the maple-birch forest type, as more than 800 million cubic feet were added during the 13 years between inventories.

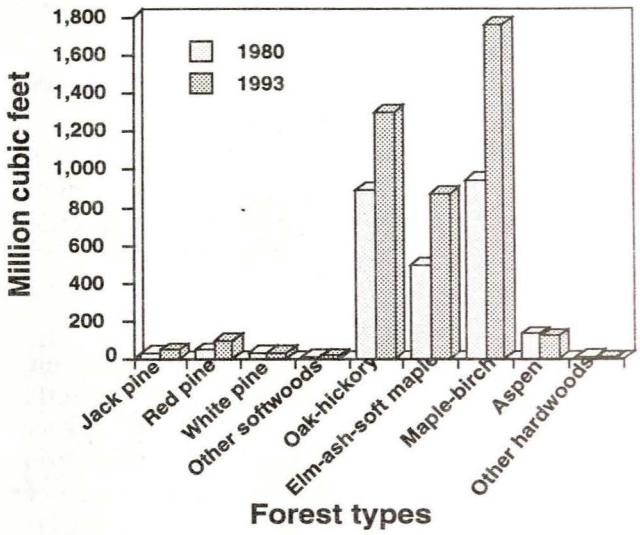

Figure 6.—*Growing-stock volume by forest type, Southern Lower Peninsula, 1980 and 1993.*

- Timberland averaged more than 1,400 cubic feet of growing-stock volume per acre in 1993, compared to about 1,000 cubic feet per acre in 1980. Timberland is becoming better stocked with larger trees as the forests that regenerated in the early 1900's mature.

- Growing-stock volume accounted for 90 percent of the total volume of all live trees in 1993. The remaining 10 percent consisted of short-log, rough, and rotten trees that were classified as live but did not meet the standards for growing stock.

- The soft maple species group represented the largest volume of sawtimber with more than 2.3 billion board feet in 1993. Select red oak and select white oak species groups were second and third in total sawtimber volume, respectively, with both having about 1.7 billion board feet in 1993.

Growth

- Total gross growing-stock average annual growth (net growth plus mortality) between 1980 and 1992 was more than 169 million cubic feet in the Southern Lower Peninsula. In comparison, the average annual net growth (total gross growth less mortality) for growing stock was 148 million cubic feet.

- From 1980 through 1992, average annual net growth for all species on timberland was nearly 50 cubic feet of growing stock per acre. This average annual net growth rate represented 3.5 percent of the growing-stock inventory in the Southern Lower Peninsula.

- Current (1992) net growth for all species on timberland was nearly 157 million cubic feet, 9 million cubic feet more than the 13-year average annual net growth between inventories.

- Soft hardwoods led all major species groups with an average of more than 70 million cubic feet of growing-stock growth per year from 1980 through 1992 (fig. 7). In addition, hard hardwoods contributed more than 65 million cubic feet of growing-stock growth annually between inventories.

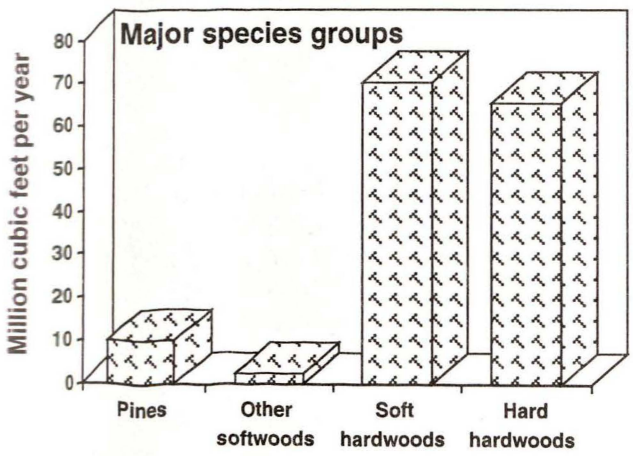

Figure 7.—*Average annual net growth of growing stock for major species groups in the Southern Lower Peninsula, 1980-1992.*

- Within hardwood species groups, soft maple, select red oak, and white/green ash all averaged more than 15 million cubic feet of growing stock net growth per year between 1980 and 1992 (fig. 8).

- Within softwood species groups, red pine and white pine averaged more than 4 million cubic feet of growing-stock net growth per year between 1980 and 1992 (fig. 9).

- Soft maple led all hardwood species groups in average sawtimber growth, with almost 90 million board feet per year from 1980 through 1992. White and green ash, select red oaks, and select white oaks averaged more than 40 million board feet of sawtimber growth each year.

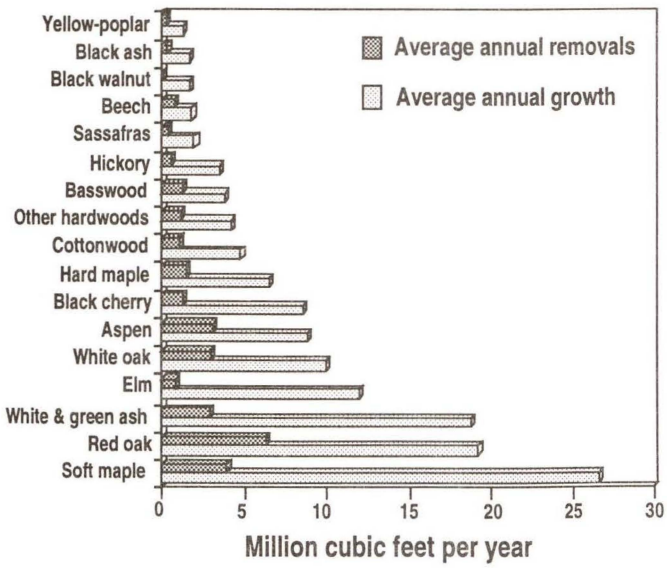

Figure 8.—*Comparison of average annual hardwood growing-stock growth with removals, by species group, Southern Lower Peninsula, 1980-1992.*

- Softwood sawtimber averaged more than 59 million board feet of net growth per year between 1980 and 1992. White pine, with more than 23 million board feet, and red pine, with nearly 20 million board feet, accounted for 73 percent of all softwood sawtimber growth between inventories.

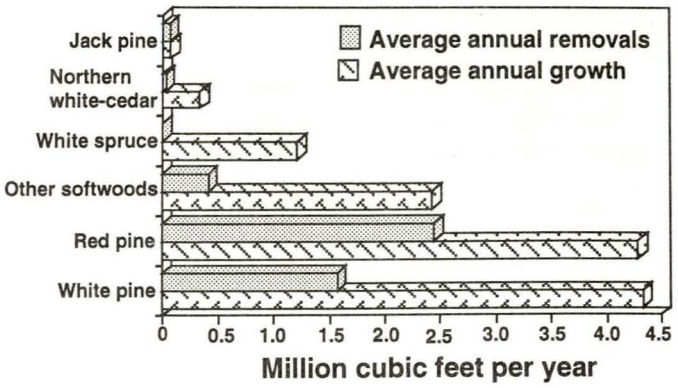

Figure 9.—*Comparison of softwood growing-stock growth with removals, by species group in the Southern Lower Peninsula, 1980-1992.*

Removals

- Annual growing-stock removals averaged less than 1 percent of total growing-stock volume and about 22 percent of the annual net growth volume between 1980 and 1992. During this period, removals averaged more than 33 million cubic feet per year.

- Current growing-stock removals were 20.3 million cubic feet in 1990 (1990 is the most recent mill survey for the Southern Lower Peninsula), which was about 12.8 million cubic feet less than the 13-year average between inventories.

- Average annual removals of hardwood growing stock represented 21 percent of hardwood average annual growth from 1980 through 1992 (fig. 8).

- Removals of hardwood growing-stock occurred primarily in the select and other red oaks, soft maple, select white oak, white and green ash, and aspen species groups. These species groups accounted for 67 percent of all hardwood growing-stock removals each year from 1980 through 1992.

- Average annual removals of softwood growing stock represented 36 percent of softwood average annual growth from 1980 through 1992 (fig. 9). Removals of softwood growing stock were primarily in red pine and white pine.

- Average annual hardwood sawtimber removals were 21 percent of average annual sawtimber growth from 1980 through 1992. Most sawtimber removals occurred in the select red oak, soft maple, and select white oak species groups, with more than 10 million board feet removed annually from each of these species groups.

Mortality

- Annually, growing-stock mortality averaged 21.5 million cubic feet between inventories. Sawtimber mortality averaged 45.8 million board feet during this time period. These totals represent annual losses of less than 1 percent of both volumes.

- Current growing-stock mortality (1992) was 20.6 million cubic feet and current sawtimber mortality (1992) was 46.9 million board feet in the Southern Lower Peninsula. Both current mortality levels were nearly identical to the 13-year average.

- Dutch elm disease continued to ravage the elm species group. From 1980 through 1992, elm represented almost 20 percent of all growing-stock mortality, but accounted for less than 5 percent of the total volume.

- Soft maple, elm, red oak, aspen, and white and green ash species groups recorded more than 60 percent of all sawtimber mortality from 1980 through 1993. Mortality of these species groups averaged more than 3 million board feet of sawtimber each year.

ACCURACY OF THE SURVEY

Forest Inventory and Analysis (FIA) information is based on a sampling procedure designed to provide reliable statistics at the State and Survey Unit levels. Consequently, the reported figures are estimates only. A measure of reliability of these figures is given by sampling errors. The level of sampling error used by FIA means the chances are two out of three that if a 100-percent inventory had been taken, using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in the Southern Lower Peninsula Unit in Michigan in 1993, 4,238.5 thousand cubic feet, has a sampling error of ± 2.19 percent (± 92.8 thousand cubic feet). Based on this sampling error, growing-stock volume from a 100-percent inventory would be expected to fall between 4,145.7 and 4,331.3 thousand cubic feet (4,238.5 ± 92.8), there being a one in three chance that this is not the case. The following tabulation shows the sampling errors for Michigan's Southern Lower Peninsula Forest Inventory:

Item	Unit totals	Sampling error
Growing stock	(Million cubic feet)	(Percent)
Volume (1993)	4,238.5	2.19
Average annual growth (1980-1992)	148.1	2.40
Average annual removals (1980-1992)	33.4	11.85
Sawtimber	(Million board feet)	
Volume (1993)	13,044.5	2.89
Average annual growth (1980-1992)	516.4	2.90
Average annual removals (1980-1992)	116.0	13.06
Timberland	(Thousand acres)	
area (1993)	3,000.7	1.29

As survey data are broken down into sections smaller than Survey Unit totals, the sampling error increases. For example, the sampling error for timberland area in a particular county is higher than that for total timberland area in the Unit. This tabulation shows the sampling errors for Unit totals. To estimate sampling error for data smaller than Unit totals, use the following formula:

$$E = \frac{(SE)\ \sqrt{\text{(Unit total area or volume)}}}{\sqrt{\text{(Volume or area smaller than Unit total)}}}$$

where:

E = sampling error in percent
SE= Unit total error for area or volume

For example, to compute the error on the area of timberland in the maple-birch type for the Unit:

1. Total area of timberland in the maple-birch forest type from table 3 = 1,300,900 acres;

2. Total area of all timberland in the Unit from table 3 = 3,000,700 acres;

3. Unit total error for timberland area from the above tabulation = 1.29 percent.

Using the above formula:

$$E = \frac{(1.29)\ \sqrt{(3{,}000{,}700)}}{\sqrt{(1{,}300{,}900)}} = \pm\ 1.96 \text{ percent.}$$

County Data

A standard FIA inventory is designed to provide sampling errors of no more than 3 percent per million acres of timberland. Thus, this Unit's 3,000.7 thousand acres of timberland required a sampling error of 1.73 percent to meet national FIA standards. Because the 35 counties in the Southern Lower Peninsula were inventoried at a single level of intensity, sampling errors will increase if data from this inventory effort are utilized below the unit level. Caution must be used accordingly. The sampling error within an individual county depends on county size and total area of timberland.

COMPARING THE FIFTH INVENTORY OF THE SOUTHERN LOWER PENINSULA WITH THE FOURTH INVENTORY

A new volume estimation procedure has been developed for the Lake States since the last survey conducted in 1980. We used this procedure to compute the 1993 volumes and to re-compute the 1980 volume for growth calculations. Although the adjustment will differ by species, the re-computed 1980 volumes will generally be greater than those shown in the original 1980 report.

Past surveys used only growing-stock trees to determine stand-size class. Current survey procedures require that stand-size class be determined on the basis of all live trees. Therefore, direct comparisons of current inventory data to old inventory data by stand-size class may be misleading.

The basic building block for estimating forest area and timber volume has been changed from the Survey Unit (as utilized during the 1980 inventory) to the county (current methodology). In the past, statistics were developed at the Unit level and prorated back to the county on the basis of photo-interpretation results. Direct development of county-level data helps users interested in more precise local data, but can make the outcome of comparisons with past estimates uncertain.

SURVEY PROCEDURES

The 1993 survey of Michigan's Southern Lower Peninsula used a growth model enhanced, two-phase sample design. Using this sampling scheme and associated estimators is similar to sampling with partial replacement, in that a set of randomly located plots is available for remeasurement and a random set of new plots is established and measured. A significant feature of the new design is stratification for disturbance on the old sample and use of a growth model to improve regression estimates made on old undisturbed forest plots (fig. 10). Detailed descriptions of the sampling and estimation procedures are presented by Hansen (1990). The growth model used was the Lake States Stand and Tree Evaluation and Modeling System (STEMS) (Belcher *et al.* 1982).

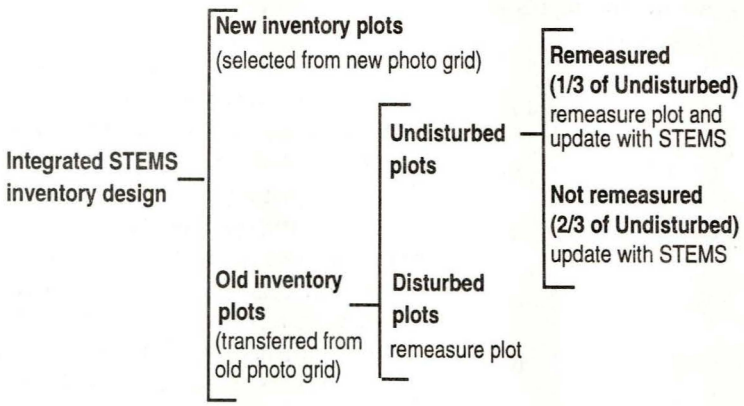

Figure 10.—*Overview of the sample design for the Southern Lower Peninsula's 1993 survey.*

Major Steps in the New Survey Design

1. Aerial photography (Phase 1)

In this phase, two sets of random points were located on current aerial photographs. The first set was new photo plots, and the second set was relocated, old ground plot locations from the 1980 inventory. Locations of the plots used in the 1980 inventory were transferred to the new photographs. The photographs were then assembled into township mosaics, and a systematic grid of 121 one-acre photo plots (each plot representing approximately 190.4 acres) was overlaid on each township mosaic. Each photo plot was examined by aerial photogrammetrists and classified stereoscopically as to its land use. If trees were present, forest type and stand-size/density classes were recorded. All of the 1980 ground plot locations were also examined for disturbance (logging, fire, catastrophic mortality, etc.). After this examination, all the old "disturbed" sample locations and one-third of the old "undisturbed" forested plots were sent to the field for survey crews to verify the photo classification and to take further measurements. All photo plot locations for the 1993 inventory were examined and classified as shown in the following tabulation.

Photo land class	Photo plots
Timberland	15,955
Reserved forest land	314
Other forest land	0
Questionable	552
Nonforest with trees	4,357
Nonforest without trees	55,822
Water	978
All classes	77,978

2. Plot measurements (Phase 2)

On plots classified as timberland, wooded pasture, or windbreak (at least 120 feet wide), a ground plot was established, remeasured, or modeled. Old plots sent to the field for remeasurement that could not be relocated were replaced with a new plot at the approximate location of the old one. Each ground plot consisted of a 10-point cluster covering 1 acre. At each point, trees 5.0 inches or more d.b.h. were sampled on a 37.5 basal area factor variable-radius plot, and trees less than 5.0 inches d.b.h. were sampled on a 1/300-acre fixed-radius plot. The measurement procedure for both the new and old sample locations was as follows:

a. New inventory plots

A random sample of the new photo plots was selected for field measurement. Ground plots were established, and measures of current classification such as land use, forest type, and ownership, as well as size and condition of all trees on the plot, were recorded. These locations were monumented for future remeasurement.

b. Old inventory plots

These plots were originally established, monumented, and measured as part of the 1980 field inventory. Procedures for these old plots were different from those for the new plots. Old plots were classed as "undisturbed" or "disturbed" in the aerial photo phase of the sampling process. All disturbed plots and a one-third sample of the undisturbed forested plots were remeasured to obtain estimates of current condition and changes since the last inventory. All trees measured on these plots in 1980 were remeasured or otherwise accounted for, and all new trees were identified and measured.

All sample plots that were forested at the time of the 1980 inventory and determined to be undisturbed until the 1993 inventory were projected to the current time (1993) using STEMS. This procedure gives projected estimates of current volume and growth for undisturbed plots. Comparison of the projected and observed values on the one-third sample of the undisturbed forest plots that were remeasured provided local calibration data to adjust the projected values of the undisturbed plots that were not remeasured. The adjustment procedure is a modified version of the method described by Smith (1983).

Undisturbed forested plots that were not remeasured played a crucial role in the new survey design. These plots, after careful comparison of past and current aerial photography, were determined to be undisturbed and had conditions that could be simulated by

STEMS. The STEMS growth model was used to "grow" the old plot and tree data to produce an estimate of current data. Thus, these plots were treated as ground plots, even though they were never visited. The plot record for each modeled plot was sent to the field for verification of current ownership information.

All old plots classified as disturbed were sent to the field for remeasurement to assess and verify changes since the last inventory. Disturbance referred to any change on a plot that was detected on aerial photos and that the STEMS growth processor could not predict, such as catastrophic mortality, cutting, seedling stands, and/or land use change.

The estimation procedure for computing statistics from this sampling design was more complicated than the simple two-phase estimation procedure used in the past. In fact, this procedure yielded two independent samples, one coming from the new photo points and the other from the old photo points that were remeasured or modeled. The following tabulation summarizes the distribution of all ground plots for the new inventory design by type of plot:

Ground land use class	Old plots remeasured	Old plots updated	New plots	Total plots
Timberland	506	233	165	904
Reserved forest land	6	0	47	53
Nonforest with trees	137	64	58	259
Nonforest without trees	1,543	1,455	606	3,604
Water	40	33	43	116
Total	2,232	1,785	919	4,936

3. Area estimates

Area estimates were made using two-phase estimation methods. In this type of estimation, a preliminary estimate of area by land use is made from the aerial photographs (Phase 1) and corrected by the plot measurements (Phase 2). A complete description of this estimation method is presented by Loetsch and Haller (1964). All area estimates were based on what existed as of January 1, 1993, in the Southern Lower Peninsula of Michigan.

4. Volume estimates

Estimates of volume per acre were made from the trees measured or modeled on the 10-point plots. Estimates of volume per acre were multiplied by the area estimates to obtain estimates of total volume. Volume estimates were based on what existed as of January 1, 1993, in the Southern Lower Peninsula of Michigan. Net cubic foot volumes were based on a modification of the method presented by Hahn (1984) for use in the Lake States. For the Southern Lower Peninsula inventory, the merchantable height equation presented was used in conjunction with Hahn's board foot volume equation (adapted from Stone's equation—Hahn 1984) to estimate gross volume.

This estimate was then corrected by species for variation in bark and cull volume to yield an estimate of net volume (Hahn 1984).

The Forest Service reports all board foot volume in International 1/4-inch rule. In Michigan, the Scribner log rule is commonly used. Scribner log rule conversion factors were derived from full tree measurements taken throughout the Lake States (Michigan, Wisconsin, and Minnesota) and an equation developed by Wiant and Castenaeda (1977). Factors, or multipliers, that can be used to convert board foot International volumes to the Scribner rule are shown in the following tabulation:

D.b.h. (inches)	Scribner rule conversion factor	
	Softwoods	Hardwoods
9.0-10.9	0.7830	—
11.0-12.9	.8287	0.8317
13.0-14.9	.8577	.8611
15.0-16.9	.8784	.8827
17.0-18.9	.8945	.8999
19.0-20.9	.9079	.9132
21.0-22.9	.9168	.9239
23.0-24.9	.9240	.9325
25.0-26.9	.9299	.9396
27.0-28.9	.9321	.9454
29.0+	.9357	.9544

5. Growth and mortality estimates

On remeasured plots, estimates of growth and mortality per acre come from the remeasured diameters of trees and from observation of trees that died between inventories. Growth reported as the average net annual growth between the two inventories (1980 and 1992) was computed from data on remeasurement plots and modeled plots using methods presented by VanDeusen *et al.* (1986). Mortality was also reported as average annual for the remeasurement period. On new plots, where trees were not remeasured, estimates of growth and mortality were obtained by using STEMS to project the growth and mortality of trees for 1 year. Growth and mortality estimates for old undisturbed plots that were updated were derived in the same manner as remeasured plots. The STEMS growth model was adjusted to meet local conditions, using data from the undisturbed remeasurement plots. As with volume, total growth and mortality estimates were obtained by multiplying the per acre estimates by area estimates. Current annual growth for 1992 was computed by using the adjusted STEMS model to grow all current inventory plots for 1 year. All growth and mortality estimates were based on growth and mortality through December 31, 1992, in the Southern Lower Peninsula of Michigan.

6. Average annual removals estimates

Average annual growing-stock and sawtimber removals (1980 to 1992) were estimated only from the remeasured plots; new plots were not used to estimate removals. These estimates are obtained from trees measured in the last survey and cut or otherwise removed from the timberland base. All removal estimates were based on removals through December 31, 1992, in the Southern Lower Peninsula of Michigan. Because remeasurement plots make up about one-half of the total ground plots, average annual removals estimates have greater sampling errors than volume and growth estimates.

Tree and Log Grades

On approximately one-third of the sample plots in Michigan's Southern Lower Peninsula, all sawtimber sample trees were graded for quality and assigned either a tree grade (hardwoods) or a log grade (softwoods). Tree and log grades were based on the evaluation of external characteristics as indicators of quality. The volume yield by grade for this sample was used to distribute the volume of the ungraded sample trees by species group. Hardwood sawtimber trees were graded according to "Hardwood tree grades for factory lumber" (Hanks 1976). The best 12-foot section of the lowest 16-foot hardwood log was used for grading. Hardwood sawtimber trees that did not meet minimum tree grade specifications for grades 1 through 3 were assigned grade 4 according to Forest Service standard specifications for hardwood construction logs described in "A guide to hardwood log grading" (Rast *et al.* 1973). Red pine and jack pine sawtimber trees were graded based on specifications described in "Forest Service log grades for southern pines" (Campbell 1964). White pine and other softwood sawtimber trees were graded according to specifications described in "Sawlog grades for eastern white pine (Ostrander and Brisbin 1971). For all softwoods, the first merchantable 16-foot log, or shorter lengths down to 12 feet, was used for grading.

Hardwood Tree Grades for Factory Lumber[a]

Grade factor	Tree grade 1	Tree grade 2	Tree grade 3
Length of grading zone (feet)	Butt 16	Butt 16	Butt 16
Length of grading section [b] (feet)	Best 12	Best 12	Best 12
D.b.h., minimum (inches)	16[c]	13	11
Diameter, minimum inside bark at top of grading section (inches)	13[c] 16 20	11[d] 12	8
Clear cuttings (on the three best faces)[e]			
Length, minimum (feet)	7 5 3	3 3	2
Number on face (maximum)	2	2 3	([f])
Yield in face length (minimum)	5/6	4/6	3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9	g[g]	50

[a] *(Hanks 1976).*

[b] *Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors.*

[c] *In basswood and ash, diameter inside bark (d.i.b.) at top of grading section must be 12 inches and d.b.h. must be 15 inches.*

[d] *Grade 2 trees can be 10 inches d.i.b. at top of grading section if otherwise meeting surface requirements for small grade 1's.*

[e] *A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.*

[f] *Unlimited.*

[g] *Fifteen percent crook and sweep or 40 percent total cull deduction are permitted in grade 2, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree's grade to 3 unless the cull deduction for rot is greater than 40 percent.*

Forest Service Standard Specifications for Hardwood Construction Logs (Tie and Timber logs)[a,b]

Position in tree	Butts and uppers
Minimum diameter, small end	8 inches +
Minimum length without trim	8 feet +
Clear cuttings	No requirements
Sweep allowance	One-fourth small end d.i.b. for each 8 feet of length. One-half d.i.b. for logs 16 feet long.
Sound surface defects:	
Single knots	Any number, if no knot has an average diameter above the callus in excess of one-third of the log diameter at point of occurrence.
Whorled knots	Any number, if the sum of knot diameters above the callus does not exceed one-third of the log diameter at point of occurrence.
Unsound defects:	
Surface	Same requirements as for sound defects if they extend into included timber. No limit if they do not.
Interior	None permitted except one shake not more than one-third the width of contained tie or timber, and one split, not over 5 inches.

[a] *These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, it may be necessary to subdivide the class into grades.*

[b] *(Rast* et al. *1973).*

Eastern White Pine Saw-log Grade Specifications[a]

Grading factor	Log grade 1	Log grade 2	Log grade 3	Log grade 4
1. Minimum scaling diameter (inches)	14[b]	6	6	6
2. Minimum log length (feet)	10[c]	8	8	8
3. Maximum weevil injury (number)	None	None	2 injuries [d]	No limit
4. Minimum face requirements	Two full length or four 50%[e] length good faces (in addition, log knots on balance of faces shall not exceed size limit of grade 2 logs).	NO GOOD FACES REQUIRED Maximum diameter of log knots on three best faces: SOUND RED KNOTS not to exceed 1/6 scaling diameter and 3" maximum OVERGROWN/DEAD/BLACK KNOTS not to exceed 1/12 scaling diameter and 1 1/2" max.	not to exceed 1/3 scaling diameter and 5" maximum not to exceed 1/6 scaling diameter and 2 1/2" max.	Includes all logs not qualifying for No. 3 or better and have at least 1/3 of their gross volume in sound wood suitable for manufacture into standard lumber
5. Maximum sweep or crook (%)	20	30	40	66 2/3
6. Maximum total scaling deduction (%)	50	50	50	66 2/3

AFTER THE TENTATIVE LOG GRADE IS ESTABLISHED FROM FACE EXAMINATION, THE LOG WILL BE REDUCED IN GRADE WHENEVER THE FOLLOWING DEFECTS ARE EVIDENT

7. Conks, punk knots, and pine borer damage on bark surface [f].
   Degrade one grade if present on one face.
   Degrade two grades if present on two faces.
   Degrade three grades if present on three or more faces.
8. Log end defects: red rot, ring shake, heavy stain, and pine borer damage outside the heart center of log[e]. Consider log as having a total of 8 quarters (4 on each end) and degrade as indicated.
   Degrade one grade if present in 2 quarters of log ends.
   Degrade two grades if present in 3 or 4 quarters of log ends.
   Degrade three grades if present in 5 or more quarters of log ends.

a. (Ostrander and Brisbin 1971)
b. 12- and 13-inch logs with four full-length good faces are acceptable.
c. 8-foot logs with four full-length good faces are acceptable.
d. 8-foot Number 3 logs limited to one weevil injury.
e. Minimum 50% length good face must be at least 6 feet.
f. Factors 7 and 8 are not cumulative (total degrade based on more serious of the two). No log is to be degraded below grade 4 if net scale is at least one-third of gross scale.

Log Grades for All Other Softwood Logs

Grade 1

1. Logs must be 16 inches d.i.b. or larger, 10 feet in length or longer, and with deduction for defect, not over 30 percent of gross scale.
2. Logs must be at least 75 percent clear on each of three faces.
3. All knots outside clear cuttings must be sound and not more than 2-1/2 inches in size.

Grade 2

1. Logs must be 12 inches d.i.b. or larger, 10 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.
2. Logs must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Logs must be 6 inches d.i.b. or larger, 8 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

Note: Diameters are d.i.b. at small end of grading section, and percent clear refers to percent clear in one continuous section.

METRIC EQUIVALENTS OF UNITS USED IN THIS REPORT

1 acre = 4,046.86 square meters or 0.405 hectare.
1,000 acres = 405 hectares.
1 cubic foot = 0.0283 cubic meter.
1 foot = 30.48 centimeters or 0.3048 meter.
1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.
1 pound = 0.454 kilogram.
1 ton = 0.907 metric ton.

TREE SPECIES GROUPS IN MICHIGAN'S SOUTHERN LOWER PENINSULA

Species names are based on Little, 1981.

SOFTWOODS

Balsam fir ..... *Abies balsamea*
Eastern redcedar ..... *Juniperus virginiana*
Tamarack ..... *Larix laricina*
White spruce ..... *Picea glauca*
Black spruce ..... *Picea mariana*
Jack pine ..... *Pinus banksiana*
Red pine ..... *Pinus resinosa*
Eastern white pine ..... *Pinus strobus*
Northern white-cedar ..... *Thuja occidentalis*
Eastern hemlock ..... *Tsuga canadensis*

HARDWOODS

Hard maple[1]
  Sugar maple ..... *Acer saccharum*
Soft maple[2]
  Red maple ..... *Acer rubrum*
  Silver maple ..... *Acer saccharinum*
Birch
  Yellow birch[1] ..... *Betula alleghaniensis*
  River birch[2] ..... *Betula nigra*
  Paper birch[2] ..... *Betula papyrifera*
Bitternut hickory[1] ..... *Carya cordiformis*
Hackberry ..... *Celtis occidentalis*
Persimmon ..... *Diospyros virginiana*
American beech ..... *Fagus grandifolia*
Ash
  White ash[1] ..... *Fraxinus americana*
  Black ash[2] ..... *Fraxinus nigra*
  Green ash[1] ..... *Fraxinus pennsylvanica*
Butternut[2] ..... *Juglans cinerea*
Black walnut[1] ..... *Juglans nigra*
White poplar ..... *Populus alba*
Balsam poplar ..... *Populus balsamifera*
Cottonwood ..... *Populus deltoides*
Bigtooth aspen[2] ..... *Populus grandidentata*
Quaking aspen[2] ..... *Populus tremuloides*
Black cherry ..... *Prunus serotina*
Select white oak[1]
  White oak ..... *Quercus alba*
  Swamp white oak ..... *Quercus bicolor*
  Bur oak ..... *Quercus macrocarpa*
Select red oak[1]
  Northern red oak ..... *Quercus rubra*
Other red oak[1]
  Northern pin oak ..... *Quercus ellipsoidalis*
  Pin oak ..... *Quercus palustris*
American basswood ..... *Tilia americana*

[1]*This species or species group is considered a hard hardwood, with an average specific gravity greater than or equal to 0.50.*

[2]*This species or species group is considered a soft hardwood, with an average specific gravity of less than 0.50.*

Elm
- Winged elm[2] ..... *Ulmus alata*
- American elm[2] ..... *Ulmus americana*
- Slippery elm[2] ..... *Ulmus rubra*
- Rock elm[1] ..... *Ulmus thomasii*

Other hardwoods
- Boxelder[2] ..... *Acer negundo*
- Ohio Buckeye[2] ..... *Aesculus glabra*
- Sweet birch[2] ..... *Betula lenta*
- Northern catalpa[2] ..... *Catalpa speciosa*

Noncommercial species
- Striped maple ..... *Acer pennsylvanicum*
- Mountain maple ..... *Acer spicatum*
- American hornbeam ..... *Carpinus caroliniana*
- Hawthorn ..... *Crataegus* spp.
- Apple ..... *Malus* spp.
- Eastern hophornbeam ..... *Ostrya virginiana*
- Canada plum ..... *Prunus nigra*
- Pin cherry ..... *Prunus pensylvanica*
- Wild plum ..... *Prunus* spp.
- Chokecherry ..... *Prunus virginiana*
- Peachleaf willow ..... *Salix amygdaloides*
- Black willow ..... *Salix nigra*
- Willow spp. ..... *Salix* spp.

DEFINITION OF TERMS

Average annual removals from growing stock.—The average net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Average annual removals of growing stock are reported for a period of several years (1980 through 1992 in this report) and are based on information obtained from remeasure-ment plots (see Survey Procedures in Appendix).

Average annual removals from sawtimber.—The average net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Average annual removals of sawtimber are reported for a period of several years (1980 through 1992 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Average net annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.

Average net annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes.

Basal area.—Tree area, in square feet, of the cross section at breast height of a single tree. When the basal areas of all trees in a stand are summed, the result is usually expressed as square feet of basal area per acre.

Butt log.—The first 12 to 16 feet from a 1-foot stump that could be, or is, cut. Minimum standards for butt logs vary by species.

Clear panel.—A section of hardwood tree surface one-fourth the circumference of the tree and at least 2 feet long, free of limbs, knots, bumps, and other indications of defect that preclude clear cuttings.

Commercial species.—Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, osage-orange, and redbud.)

County and municipal land.—Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Cropland.—Land under cultivation within the past 24 months; including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards, and land in soil improvement crops, but excluding land cultivated in developing improved pasture.

Cull.—Portions of a tree that are unusable for industrial wood products because of rot, missing or dead material, or other defect.

Diameter class.—A classification of trees based on diameter outside bark, measured at breast height (d.b.h.). Two-inch diameter classes are commonly used in Forest Inventory and Analysis, with the even inch the

approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet (1.37 m) above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Face.—A section of the tree surface one-fourth the circumference of the tree extending the full length of the log.

Farm.—Any place from which $1,000 or more of agricultural products were produced and sold during the year.

Farmer-owned land.—Land owned by farm operators whether part of the farmstead or not. (Note: Excludes land leased by farm operators from nonfarm owners, such as railroad companies and States.)

Forest industry land.—Land owned by companies or individuals operating wood-using plants.

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide. (See definitions for Land, Timberland, Reserved forest land, Stocking, and Water.)

Forest type.—A classification of forest land based on the species forming a plurality of live tree stocking. Major forest types in the State are:

Jack pine.—Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

Red pine.—Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)

Eastern white pine.—Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.)

Balsam fir.—Forests in which balsam fir and white spruce comprise a plurality of the stocking with balsam fir the most common. (Common associates include white spruce, aspen, maple, birch, northern white-cedar, and tamarack.)

White spruce.—Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include balsam fir, aspen, maple, birch, northern white-cedar, and tamarack.)

Black spruce.—Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar.—Forests in which swamp conifer species comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)

Tamarack.—Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Oak-hickory.—Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include jack pine, beech, yellow-poplar, elm, and maple.)

Elm-ash-soft maple.—Forests in which lowland elm, ash, red maple, silver maple, and cottonwood, singly or in combination, comprise a plurality of the stocking. (Common associates include birch, spruce, and balsam fir.)

Maple-birch.—Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include birch, spruce, and balsam fir.)

Aspen.—Forests in which quaking aspen or bigtooth aspen, singly or in combination,

comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)

Paper birch.—Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)

Balsam poplar.—Forests in which balsam poplar comprises a plurality of the stocking. (Common associates include aspen, elm, and ash.)

Growing-stock tree.—A live tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0 inch top diameter (outside bark) of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods.—Hardwood species with an average specific gravity greater than 0.50 such as oaks, hard maple, and hickories.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous. (See Soft hardwoods and Hard hardwoods.)

Improved pasture.—Land currently improved for grazing by cultivation, seeding, irrigation, or clearing of trees and brush.

Indian owned land.—Land owned by Native Americans or land held in trust by the United States for tribes or individual Native Americans.

Industrial wood.—All roundwood products except residential fuelwood.

Land.—A. *Bureau of the Census.* Dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (except tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

B. *Forest Inventory and Analysis.* The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is less than 1 acre.

Live trees.—Growing-stock, rough, and rotten trees 1.0 inch d.b.h. and larger.

Log grade.—A log classification based on external characteristics as indicators of quality or value. (See Appendix for specific grading factors used.)

Marsh.—Nonforest land that characteristically supports low, generally herbaceous or shrubby vegetation and that is intermittently covered with water.

Merchantable.—Refers to a pulpwood or saw-log section that meets pulpwood or saw-log specifications, respectively.

Miscellaneous Federal land.—Federal land other than National Forest.

Miscellaneous private corporation.—Lands privately owned by any coporation other than forest industry or farmer.

Miscellaneous private land.—Privately owned land other than forest-industry, miscellaneous private corporation and farmer-owned land.

Mortality.—The volume of sound wood in growing-stock and sawtimber trees that die annually.

National Forest land.—Federal land that has been legally designated as National Forest or purchase units, and other land administered by the USDA Forest Service.

Net volume.—Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products. Classified in volume tables as rough trees.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width,

and 1- to 39.9-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.)

a. Nonforest land without trees.—Nonforest land with no live trees present.

b. Nonforest land with trees.—Nonforest land with one or more trees per acre at least 5 inches d.b.h.

Nonstocked land.—Forest land less than 16.7 percent stocked with live trees.

Other removals.—Growing-stock trees removed but not utilized for products, or trees left standing but "removed" from the timberland classification by land use change. Examples are removals from cultural operations such as timber stand improvement work, land clearing, and changes in land use.

Ownership size class.—The amount of timberland owned by one owner, regardless of the number of parcels.

Pasture.—Land presently used for grazing or under cultivation to develop grazing.

Poletimber stand.—(See Stand-size class.)

Poletimber tree.—A tree of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size (9.0 inches d.b.h. for softwoods, 11.0 inches d.b.h. for hardwoods).

Potential productivity class.—A classification of forest lands in terms of inherent capacity to grow crops of industrial wood. The class identifies the potential growth in merchantable cubic feet/acre/year at culmination of mean annual increment of fully stocked natural stands.

Reserved forest land.—Forest land withdrawn from timber utilization through statute, administrative regulation, designation, or exclusive use for Christmas tree production, as indicated by annual shearing.

Rotten tree.—A tree that does not meet regional merchantability standards because of excessive unsound cull.

Rough tree.—A tree that does not meet regional merchantability standards because of excessive sound cull. May include noncommercial tree species.

Roundwood products.—Logs, bolts or other round sections (including chips from roundwood) cut from trees for industrial or consumer uses. (Note: Includes saw logs, veneer logs and bolts; cooperage logs and bolts; pulpwood; fuelwood; pilings; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

Salvable dead tree.—A standing or down dead tree considered merchantable by regional standards.

Sapling.—A live tree 1.0 to 5.0 inches d.b.h.

Sapling-seedling stand.—(See Stand-size class.)

Saw log.—A log meeting minimum standards of diameter, length, and defect. A saw log must be at least 8 feet long, sound, straight, have a minimum diameter outside bark (d.o.b.) of 7.0 inches for softwoods and 9.0 inches for hardwoods, or have other combinations of size and defect specified by regional standards.

Saw-log portion.—That part of the bole of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber stand.—(See Stand-size class.)

Sawtimber tree.—A tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume.—Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified

otherwise), from the stump to a minimum 7 inches top d.o.b. for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Seedling.—A live tree less than 1.0 inch d.b.h. that is expected to survive. Only softwood seedlings more than 6 inches tall and hardwood seedlings more than 1 foot tall are counted.

Short-log (rough tree).—Sawtimber-size trees of commercial species that contain at least one merchantable 8- to 11-foot saw log but not a 12-foot saw log.

Site index.—An expression of forest site quality based on the height of a free-growing dominant, or codominant tree of a representative species in the forest type at age 50.

Soft hardwoods.—Hardwood species with an average specific gravity less than 0.50 such as gum, yellow-poplar, cottonwood, red maple, basswood, and willow.

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Stand.—A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-age class.—Age of main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Stand-size class.—A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

a. Sawtimber stands.—Stands with half or more of live stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

b. Poletimber stands.—Stands with half or more live stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

c. Sapling-seedling stands.—Stands with more than half of the live stocking in saplings and/or seedlings.

State land.—Land owned by States, or leased to them for 50 years or more.

Stocking.—The degree of occupancy of land by live trees, measured by basal area; and/or the number of trees in a stand by size or age and spacing, compared to the basal area; and/or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

A stocking percent of 100 indicates full utilization of the site and is equivalent to 80 square feet of basal area per acre in trees 5.0 inches d.b.h. and larger. In a stand of trees less than 5.0 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5.0 inches d.b.h.

Stands are grouped into the following stocking classes:

Overstocked stands.—Stands in which stocking of live trees is 133 percent or more.

Fully stocked stands.—Stands in which stocking of live trees is from 100.0 to 132.9 percent.

Medium stocked stands.—Stands in which stocking of live trees is from 60.0 to 99.9 percent.

Poorly stocked stands.—Stands in which stocking of live trees is from 16.7 to 59.9 percent.

Nonstocked areas.—Timberland on which stocking of live trees is less than 16.7 percent.

Timberland.—Forest land that is producing, or capable of producing, in excess of 20 cubic feet per acre per year of industrial wood crops under natural conditions. In addition, the forest land must not be withdrawn from timber utilization, and not associated with urban or rural development. Currently inaccessible and inoperable areas are included.

Tree.—A woody plant usually having one or more perennial stems, a more or less definitely formed crown of foliage, and a height of at least 12 feet at maturity.

Tree grade.—A tree classification based on external characteristics as indicators of quality or value, used for hardwood species. (See Appendix for specific grading factors used.)

Tree size class.—A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Unproductive forest land.—Forest land incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions because of adverse site conditions. (Note: Adverse conditions include sterile soils, dry climate, poor drainage, high elevation, steepness, and rockiness.)

Upper stem portion.—That part of the bole of sawtimber trees above the saw-log top to a minimum top diameter of 4.0 inches outside bark, or to the point where the central stem breaks into limbs.

Water.—*(a) Bureau of the Census.*—Permanent inland water surfaces, such as lakes, reservoirs, and ponds at least 40 acres in area; and streams, sloughs, estuaries, and canals at least one-eighth of a statute mile wide.

(b) Noncensus.—Permanent inland water surfaces, such as lakes, reservoirs, and ponds from 1 to 39.9 acres in area; and streams, sloughs, estuaries, and canals from 120 feet to one-eighth of a statute mile wide.

Wooded pasture.—Improved pasture with more than 16.7 percent stocking in live trees but less than 25 percent stocking in growing-stock trees. Area is currently improved for grazing or there is evidence of grazing.

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(In thousand acres)

County	Total area	Forest land			Nonforest land	Census water
		All forest land	Timberland	Reserved timber-land		
Allegan	1,173.4	179.9	178.4	1.5	349.7	643.8
Barry	369.2	111.2	111.2	--	244.7	13.3
Berrien	1,012.1	68.3	67.0	1.3	297.1	646.7
Branch	332.5	54.4	54.4	--	270.4	7.7
Calhoun	459.8	111.0	110.6	0.4	342.6	6.2
Cass	325.4	76.9	76.9	--	238.1	10.4
Clinton	367.7	55.4	53.8	1.6	310.3	2.0
Eaton	370.6	82.1	82.1	--	286.9	1.6
Genesee	415.6	64.9	64.9	--	344.5	6.2
Gratiot	365.8	49.2	49.2	--	315.7	0.9
Hillsdale	388.6	74.1	74.1	--	309.2	5.3
Huron	1,367.8	66.2	64.5	1.7	469.2	832.4
Ingham	359.0	62.0	62.0	--	295.9	1.1
Ionia	371.4	74.6	74.6	--	292.3	4.5
Jackson	463.2	82.3	82.3	--	369.9	11.0
Kalamazoo	371.3	79.0	75.0	4.0	280.6	11.7
Kent	558.2	155.5	155.5	--	392.5	10.2
Lapeer	424.4	110.3	109.4	0.9	308.5	5.6
Lenawee	487.3	55.2	55.2	--	425.2	6.9
Livingston	374.7	100.0	94.1	5.9	263.8	10.9
Macomb	364.7	61.4	60.6	0.8	246.1	57.2
Monroe	435.3	37.9	37.9	--	314.9	82.5
Montcalm	461.5	133.0	133.0	--	320.2	8.3
Muskegon	933.9	162.2	159.9	2.3	163.6	608.1
Oakland	581.2	137.4	111.2	26.2	421.2	22.6
Ottawa	1,044.6	79.1	79.1	--	283.0	682.5
Saginaw	522.1	98.9	98.9	--	418.8	4.4
St. Clair	532.8	79.7	78.3	1.4	383.9	69.2
St. Joseph	333.6	65.6	65.6	--	256.8	11.2
Sanilac	1,018.0	79.9	79.9	--	537.0	401.1
Shiawassee	346.1	50.2	50.2	--	294.7	1.2
Tuscola	584.9	115.5	115.5	--	404.6	64.8
Van Buren	697.8	122.3	122.3	--	268.8	306.7
Washtenaw	462.5	82.2	82.2	--	372.3	8.0
Wayne	430.2	35.9	30.9	5.0	357.1	37.2
All counties	19,107.2	3,053.7	3,000.7	53.0	11,450.1	4,603.4

Table 2.--Area of timberland by county and ownership class, Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	Ownership class					
	All owners	National forest	State	County and municipal	Misc. private-corporation	Misc. private-individual/farmer
Allegan	178.4	--	55.8	--	8.0	114.6
Barry	111.2	--	19.8	--	--	91.4
Berrien	67.0	--	2.7	9.6	5.4	49.3
Branch	54.4	--	--	3.0	--	51.4
Calhoun	110.6	--	--	--	7.6	103.0
Cass	76.9	--	--	--	8.1	68.8
Clinton	53.8	--	--	2.6	7.4	43.8
Eaton	82.1	--	--	--	28.9	53.2
Genesee	64.9	--	--	3.7	--	61.2
Gratiot	49.2	--	7.3	--	--	41.9
Hillsdale	74.1	--	--	--	--	74.1
Huron	64.5	--	9.7	2.8	--	52.0
Ingham	62.0	--	3.6	--	3.7	54.7
Ionia	74.6	--	4.0	3.8	--	66.8
Jackson	82.3	--	13.1	2.6	8.1	58.5
Kalamazoo	75.0	--	6.2	5.8	--	63.0
Kent	155.5	--	1.5	--	8.3	145.7
Lapeer	109.4	--	15.8	2.9	10.4	80.3
Lenawee	55.2	--	--	--	2.2	53.0
Livingston	94.1	--	5.6	--	17.6	70.9
Macomb	60.6	--	2.4	9.0	29.5	19.7
Monroe	37.9	--	1.5	--	6.3	30.1
Montcalm	133.0	1.8	18.5	5.9	10.3	96.5
Muskegon	159.9	12.4	8.8	21.8	15.5	101.4
Oakland	111.2	--	--	--	32.0	79.2
Ottawa	79.1	--	--	5.1	9.0	65.0
Saginaw	98.9	--	9.6	--	--	89.3
St. Clair	78.3	--	11.0	--	16.2	51.1
St. Joseph	65.6	--	4.6	--	--	61.0
Sanilac	79.9	--	2.9	--	8.7	68.3
Shiawassee	50.2	--	--	--	3.0	47.2
Tuscola	115.5	--	21.2	--	--	94.3
Van Buren	122.3	--	--	1.1	3.3	117.9
Washtenaw	82.2	--	12.4	3.5	6.8	59.5
Wayne	30.9	--	--	2.4	3.5	25.0
All counties	3,000.7	14.2	238.0	85.6	259.8	2,403.1

Table 3.--Area of timberland by county and forest type, Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	All types	Forest type												
		Jack pine	Red pine	White pine	White spruce	Northern white-cedar	Tamarack	Oak-hickory	Elm-ash-soft maple	Maple-birch	Aspen	Paper birch	Balsam poplar	Non-stocked
Allegan	178.4	4.6	0.6	2.5	--	--	--	71.3	27.8	67.6	4.0	--	--	--
Barry	111.2	2.2	--	--	1.1	--	--	44.7	13.0	50.2	--	--	--	--
Berrien	67.0	4.0	--	--	--	--	--	16.8	15.0	31.2	--	--	--	--
Branch	54.4	--	--	--	--	--	--	8.8	24.3	21.3	--	--	--	--
Calhoun	110.6	--	--	--	--	--	--	18.9	17.3	72.3	2.1	--	--	--
Cass	76.9	0.2	--	--	--	--	--	17.6	14.8	44.3	--	--	--	--
Clinton	53.8	--	--	--	--	--	--	13.1	15.1	19.4	--	--	--	6.2
Eaton	82.1	--	--	--	--	--	--	3.7	46.2	32.2	--	--	--	--
Genesee	64.9	1.6	--	--	--	--	--	15.2	18.9	27.5	--	1.7	--	--
Gratiot	49.2	--	--	2.1	--	--	--	19.2	1.5	26.4	--	--	--	--
Hillsdale	74.1	4.2	--	4.7	--	--	0.7	11.8	16.7	36.0	--	--	--	--
Huron	64.5	--	--	--	--	--	--	2.9	25.1	25.1	8.5	--	2.9	--
Ingham	62.0	--	--	--	--	--	--	3.6	11.0	47.4	--	--	--	--
Ionia	74.6	--	--	--	3.8	--	--	11.6	3.9	34.6	20.7	--	--	--
Jackson	82.3	2.7	--	--	--	--	--	36.4	10.9	32.3	--	--	--	--
Kalamazoo	75.0	7.1	5.7	--	--	--	--	16.0	13.8	29.2	3.2	--	--	--
Kent	155.5	2.4	13.2	--	--	--	--	45.2	29.4	56.3	9.0	--	--	--
Lapeer	109.4	--	6.7	--	3.7	--	3.0	21.3	33.3	38.4	3.0	--	--	--
Lenawee	55.2	--	--	--	--	--	--	11.3	13.0	28.7	2.2	--	--	--
Livingston	94.1	--	2.6	--	--	--	--	39.9	22.7	28.9	--	--	--	--
Macomb	60.6	--	--	--	--	--	--	12.9	25.6	22.1	--	--	--	--
Monroe	37.9	--	--	--	--	--	--	10.5	3.4	24.0	--	--	--	--
Montcalm	133.0	--	4.3	2.7	--	--	4.1	29.9	39.1	42.9	10.0	--	--	--
Muskegon	159.9	7.1	11.6	0.9	--	--	--	71.2	15.5	40.5	6.5	--	--	6.6
Oakland	111.2	--	--	--	--	--	--	24.6	23.6	60.4	2.6	--	--	--
Ottawa	79.1	4.9	4.7	--	--	--	--	15.2	18.1	32.8	3.4	--	--	--
Saginaw	98.9	1.1	--	5.3	--	--	--	28.1	22.2	38.5	3.7	--	--	--
St. Clair	78.3	--	--	--	--	--	--	14.4	11.0	48.3	2.8	--	--	1.8
St. Joseph	65.6	--	--	2.8	--	--	--	25.0	14.5	21.0	2.3	--	--	--
Sanilac	79.9	--	--	2.6	--	--	--	--	13.2	45.1	10.8	5.3	2.9	--
Shiawassee	50.2	--	--	--	--	--	--	16.6	17.2	16.4	--	--	--	--
Tuscola	115.5	--	--	--	--	6.0	--	3.1	39.1	43.3	24.0	--	--	--
Van Buren	122.3	--	1.1	--	--	--	--	19.0	22.1	77.7	2.4	--	--	--
Washtenaw	82.2	--	--	--	--	--	--	37.2	12.5	31.4	--	--	1.1	--
Wayne	30.9	--	--	--	--	--	--	9.4	14.3	7.2	--	--	--	--
All counties	3,000.7	42.1	50.5	23.6	8.6	6.0	7.8	746.4	665.1	1,300.9	121.2	7.0	6.9	14.6

Table 4.--Area of timberland by county and stand-size class, Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling and Seedling	Non-stocked
Allegan	178.4	111.7	35.4	31.3	--
Barry	111.2	67.3	15.4	28.5	--
Berrien	67.0	61.2	4.0	1.8	--
Branch	54.4	30.4	11.5	12.5	--
Calhoun	110.6	67.8	30.8	12.0	--
Cass	76.9	50.7	22.2	4.0	--
Clinton	53.8	22.8	10.4	14.4	6.2
Eaton	82.1	48.5	33.6	--	--
Genesee	64.9	27.2	8.1	29.6	--
Gratiot	49.2	29.3	5.5	14.4	--
Hillsdale	74.1	39.3	21.8	13.0	--
Huron	64.5	37.4	15.3	11.8	--
Ingham	62.0	43.1	7.9	11.0	--
Ionia	74.6	38.4	36.2	--	--
Jackson	82.3	66.0	8.0	8.3	--
Kalamazoo	75.0	42.7	18.3	14.0	--
Kent	155.5	83.7	34.7	37.1	--
Lapeer	109.4	51.6	21.9	35.9	--
Lenawee	55.2	33.2	13.3	8.7	--
Livingston	94.1	84.3	4.6	5.2	--
Macomb	60.6	19.1	19.1	22.4	--
Monroe	37.9	27.2	9.7	1.0	--
Montcalm	133.0	83.2	32.3	17.5	--
Muskegon	159.9	86.0	39.6	27.7	6.6
Oakland	111.2	52.8	27.3	31.1	--
Ottawa	79.1	50.7	19.0	9.4	--
Saginaw	98.9	31.8	38.1	29.0	--
St. Clair	78.3	46.4	15.2	14.9	1.8
St. Joseph	65.6	48.2	9.2	8.2	--
Sanilac	79.9	19.1	19.9	40.9	--
Shiawassee	50.2	36.2	5.4	8.6	--
Tuscola	115.5	34.0	36.4	45.1	--
Van Buren	122.3	73.9	18.4	30.0	--
Washtenaw	82.2	60.0	6.7	15.5	--
Wayne	30.9	18.9	7.9	4.1	--
All counties	3,000.7	1,724.1	663.1	598.9	14.6

Table 5.--Area of timberland by county and potential productivity class, Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	All classes	Potential productivity class (cubic feet of growth per acre per year)				
		165+	120-164	85-119	50-84	20-49
Allegan	178.4	7.9	5.9	59.2	86.1	19.3
Barry	111.2	7.8	8.3	50.7	34.1	10.3
Berrien	67.0	6.9	6.7	38.4	15.0	--
Branch	54.4	--	6.1	29.3	19.0	--
Calhoun	110.6	3.8	7.5	60.7	38.6	--
Cass	76.9	4.3	9.1	37.7	20.8	5.0
Clinton	53.8	--	--	25.7	17.1	11.0
Eaton	82.1	3.6	11.0	42.7	24.8	--
Genesee	64.9	--	3.7	37.7	18.5	5.0
Gratiot	49.2	--	--	29.4	15.9	3.9
Hillsdale	74.1	--	12.9	31.4	24.4	5.4
Huron	64.5	--	8.6	17.3	27.0	11.6
Ingham	62.0	3.6	7.2	40.2	9.3	1.7
Ionia	74.6	3.8	15.5	19.1	36.2	--
Jackson	82.3	5.4	8.0	35.2	23.9	9.8
Kalamazoo	75.0	5.9	9.6	25.9	23.8	9.8
Kent	155.5	5.1	14.0	53.1	61.8	21.5
Lapeer	109.4	--	9.7	47.7	37.7	14.3
Lenawee	55.2	4.4	2.2	24.6	24.0	--
Livingston	94.1	--	--	54.8	36.3	3.0
Macomb	60.6	--	3.9	22.9	30.0	3.8
Monroe	37.9	--	--	32.5	3.9	1.5
Montcalm	133.0	--	9.4	48.1	49.7	25.8
Muskegon	159.9	--	3.4	42.1	70.7	43.7
Oakland	111.2	--	5.6	39.9	43.4	22.3
Ottawa	79.1	--	8.0	19.5	42.4	9.2
Saginaw	98.9	--	--	23.8	71.8	3.3
St. Clair	78.3	--	4.8	47.8	25.7	--
St. Joseph	65.6	9.2	4.7	27.9	17.4	6.4
Sanilac	79.9	--	--	40.4	39.5	--
Shiawassee	50.2	--	2.8	33.7	13.7	--
Tuscola	115.5	2.6	--	43.1	63.7	6.1
Van Buren	122.3	--	11.2	44.8	61.7	4.6
Washtenaw	82.2	--	--	38.2	39.6	4.4
Wayne	30.9	--	2.3	19.6	3.5	5.5
All counties	3,000.7	74.3	202.1	1,285.1	1,171.0	268.2

Table 6.--Area of timberland by county and stocking class of growing-stock trees [1], Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	Stocking class of growing-stock trees					
	All classes	Non-[2] stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
Allegan	178.4	--	27.2	57.0	70.5	23.7
Barry	111.2	--	23.7	32.5	41.0	14.0
Berrien	67.0	--	8.1	22.2	24.4	12.3
Branch	54.4	--	1.9	34.5	15.0	3.0
Calhoun	110.6	--	14.6	51.0	41.3	3.7
Cass	76.9	--	4.3	42.1	17.6	12.9
Clinton	53.8	8.8	16.9	20.4	7.7	--
Eaton	82.1	6.4	43.5	13.9	10.9	7.4
Genesee	64.9	--	18.0	19.6	14.9	12.4
Gratiot	49.2	--	6.5	26.7	16.0	--
Hillsdale	74.1	4.4	15.6	21.0	28.4	4.7
Huron	64.5	2.9	17.3	19.2	19.5	5.6
Ingham	62.0	--	8.5	28.2	25.3	--
Ionia	74.6	--	28.6	19.0	23.1	3.9
Jackson	82.3	--	18.8	36.8	21.3	5.4
Kalamazoo	75.0	1.3	12.2	30.8	25.0	5.7
Kent	155.5	1.1	23.7	72.5	45.7	12.5
Lapeer	109.4	--	25.0	71.5	12.9	--
Lenawee	55.2	4.4	2.2	35.3	10.8	2.5
Livingston	94.1	--	30.6	42.6	18.3	2.6
Macomb	60.6	25.7	5.2	15.2	8.2	6.3
Monroe	37.9	--	13.0	1.9	17.7	5.3
Montcalm	133.0	--	31.7	57.2	30.8	13.3
Muskegon	159.9	6.6	18.0	53.3	69.6	12.4
Oakland	111.2	2.6	34.8	35.1	32.9	5.8
Ottawa	79.1	7.7	10.4	33.7	22.3	5.0
Saginaw	98.9	--	12.6	37.8	37.4	11.1
St. Clair	78.3	1.8	11.5	27.6	20.2	17.2
St. Joseph	65.6	2.7	5.4	26.9	24.9	5.7
Sanilac	79.9	--	24.4	39.4	10.3	5.8
Shiawassee	50.2	3.0	--	21.9	19.9	5.4
Tuscola	115.5	--	30.0	34.9	44.6	6.0
Van Buren	122.3	2.5	30.9	49.7	29.3	9.9
Washtenaw	82.2	7.4	17.0	31.0	19.8	7.0
Wayne	30.9	--	4.1	19.8	4.7	2.3
All counties	3,000.7	89.3	596.2	1,182.2	882.2	250.8

[1] This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "all live" by "growing-stock."

[2] Timberland insufficiently stocked with growing-stock trees.

Table 7.--Area of timberland by forest type and ownership class, Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

Forest type	Ownership class					
	All owners	National forest	State	County and municipal	Misc. private-corporation	Misc. private-individual/farmer
Jack pine	42.1	2.1	7.1	2.4	--	30.5
Red pine	50.5	4.8	14.3	8.8	--	22.6
White pine	23.6	--	--	--	--	23.6
White spruce	8.6	--	--	--	--	8.6
Northern white-cedar	6.0	--	--	--	--	6.0
Tamarack	7.8	--	--	--	3.0	4.8
Oak-hickory	746.4	3.1	110.3	19.9	62.7	550.4
Elm-ash-soft maple	665.1	--	37.4	12.3	79.7	535.7
Maple-birch	1,300.9	4.2	45.2	36.0	114.4	1,101.1
Aspen	121.2	--	23.7	6.2	--	91.3
Paper birch	7.0	--	--	--	--	7.0
Balsam poplar	6.9	--	--	--	--	6.9
Nonstocked	14.6	--	--	--	--	14.6
All types	3,000.7	14.2	238.0	85.6	259.8	2,403.1

Table 8.--Area of timberland by ownership class and stocking class of growing-stock trees [1], Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

Ownership class	All classes	Stocking class of growing-stock trees				
		Non-stocked [2]	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
National forest	14.2	--	0.6	4.8	7.0	1.8
State	238.0	2.2	24.7	75.4	93.2	42.5
County and municipal	85.6	--	7.9	31.7	29.5	16.5
Misc. private-corporation	259.8	35.1	59.5	93.8	57.5	13.9
Misc. private-individual/farmer	2,403.1	52.0	503.5	976.5	695.0	176.1
All owners	3,000.7	89.3	596.2	1,182.2	882.2	250.8

[1] This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "all live" by "growing-stock."

[2] Timberland insufficiently stocked with growing-stock trees.

Table 9.--Area of timberland by forest type and stand-size class, Southern Lower Peninsula, Michigan, 1993

(In thousand acres)

Forest type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling and seedling	Non-stocked
Jack pine	42.1	6.7	30.6	4.8	--
Red pine	50.5	35	13.1	2.4	--
White pine	23.6	12	5.3	6.3	--
White spruce	8.6	--	4.9	3.7	--
Northern white-cedar	6.0	3.0	3.0	--	--
Tamarack	7.8	3.0	0.7	4.1	--
Oak-hickory	746.4	560.8	102.4	83.2	--
Elm-ash-soft maple	665.1	388.0	162.6	114.5	--
Maple-birch	1,300.9	694.5	277.8	328.6	--
Aspen	121.2	21.1	55.8	44.3	--
Paper birch	7.0	--	--	7.0	--
Balsam poplar	6.9	--	6.9	--	--
Nonstocked	14.6	--	--	--	14.6
All types	3,000.7	1,724.1	663.1	598.9	14.6

Table 10.--Number of all live trees on timberland by species group and diameter class, Southern Lower Peninsula, Michigan, 1993

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height) 1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9-	29.0+
Softwoods													
Jack pine	5,676	1,482	1,639	1,137	806	331	242	39	--	--	--	--	--
Red pine	16,006	2,139	2,208	4,056	3,499	2,243	1,270	400	164	27	--	--	--
White pine	23,584	8,874	4,876	3,524	2,216	2,016	956	429	191	194	94	197	17
White spruce	4,893	555	2,326	1,365	249	344	28	26	--	--	--	--	--
Black spruce	81	81	--	--	--	--	--	--	--	--	--	--	--
Balsam fir	29	--	--	--	--	29	--	--	--	--	--	--	--
Hemlock	1,638	558	433	297	121	37	38	76	22	12	15	27	2
Tamarack	5,257	2,853	492	844	642	198	129	86	--	5	--	4	4
Eastern redcedar	2,535	1,635	435	286	113	47	19	--	--	--	--	--	--
Northern white-cedar	11,473	5,725	3,087	1,501	679	307	142	20	7	5	--	--	--
Other softwoods	11,563	2,507	3,371	1,901	2,039	997	544	121	70	--	13	--	--
Total	82,735	26,409	18,867	14,911	10,364	6,549	3,368	1,197	454	243	122	228	23
Hardwoods													
Select white oak	65,321	24,876	10,250	9,031	5,375	4,643	3,012	2,353	1,954	1,420	872	1,262	273
Select red oak	59,906	25,012	8,025	8,386	3,752	3,456	3,328	2,889	1,858	1,151	742	1,176	131
Other red oak	33,140	12,991	4,577	4,497	2,945	2,334	1,871	1,305	1,233	584	374	366	63
Select hickory	19,843	9,676	2,946	1,926	1,382	1,429	1,020	760	379	171	85	68	1
Other hickory	17,308	8,452	3,214	1,740	1,277	951	839	427	201	134	48	25	--
Basswood	44,131	21,190	10,013	4,918	3,490	1,599	1,343	570	381	262	180	170	15
Beech	12,645	7,573	1,223	1,241	605	476	317	288	235	190	113	356	28
Yellow birch	6,798	3,326	2,149	413	402	193	110	109	51	14	7	24	--
Hard maple	79,900	52,202	12,342	6,210	2,688	2,253	1,364	767	757	549	298	381	89
Soft maple	232,005	119,415	48,628	23,941	14,575	9,399	5,952	3,808	2,379	1,543	897	1,231	237
Elm	194,830	109,353	48,596	20,002	8,691	4,743	1,976	842	416	128	29	54	--
Black ash	31,867	16,528	8,066	2,596	2,710	1,006	443	337	53	103	8	17	--
White and green ash	157,501	79,289	33,075	19,280	11,376	5,482	3,699	2,273	1,319	833	369	455	51
Sycamore	977	288	--	156	24	149	116	61	20	54	12	74	23
Cottonwood	9,406	1,402	1,841	1,874	954	678	709	577	509	343	159	261	99
Willow	5,965	1,572	1,013	1,073	565	461	416	207	278	95	93	144	48
Hackberry	2,609	1,018	844	535	112	49	12	11	9	19	--	--	--
Balsam poplar	1,228	402	120	254	139	128	38	71	15	17	15	29	--
Bigtooth aspen	23,473	6,882	4,152	4,079	3,141	2,550	1,394	929	253	69	12	12	--
Quaking aspen	49,043	20,973	9,826	9,820	4,675	2,523	725	283	119	88	6	5	--
Paper birch	10,214	4,080	2,259	1,379	1,699	493	243	22	32	--	7	--	--
Tupelo	3,525	1,488	703	878	246	114	29	46	--	--	--	21	--
Black cherry	112,814	66,473	18,074	12,153	6,527	4,194	2,392	1,603	563	488	188	152	7
Black walnut	8,215	2,214	1,203	1,607	1,049	898	517	348	153	114	55	53	4
Butternut	2,457	639	1,059	161	240	104	138	64	21	13	6	12	--
Yellow-poplar	3,188	903	501	499	167	259	267	158	165	60	116	87	6
Sassafras	57,042	34,362	11,062	5,851	3,298	1,373	695	281	72	39	--	9	--
Other hardwoods	55,770	40,935	6,939	3,883	2,155	866	618	186	109	25	42	9	3
Noncommercial spp.	180,590	139,617	30,710	7,262	1,900	893	135	39	9	--	5	16	4
Total	1,481,711	813,131	283,410	155,645	86,159	53,696	33,718	21,614	13,543	8,506	4,738	6,469	1,082
All species	1,564,446	839,540	302,277	170,556	96,523	60,245	37,086	22,811	13,997	8,749	4,860	6,697	1,105

Table 11.--Number of growing-stock trees on timberland by species group and diameter class, Southern Lower Peninsula, Michigan, 1993

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height) 1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9-	29.0+
Softwoods													
Jack pine	5,535	1,482	1,582	1,098	806	297	231	39	--	--	--	--	--
Red pine	15,257	2,139	2,166	3,850	3,201	2,144	1,212	390	128	27	--	--	--
White pine	22,546	8,874	4,876	3,160	1,979	1,754	894	374	191	147	94	186	17
White spruce	4,893	555	2,326	1,365	249	344	28	26	--	--	--	--	--
Black spruce	81	81	--	--	--	--	--	--	--	--	--	--	--
Balsam fir	29	--	--	--	--	29	--	--	--	--	--	--	--
Hemlock	1,581	558	433	240	121	37	38	76	22	12	15	27	2
Tamarack	5,041	2,853	492	654	642	180	129	86	--	5	--	--	--
Eastern redcedar	2,305	1,437	435	286	113	25	9	--	--	--	--	--	--
Northern white-cedar	10,727	5,725	2,715	1,444	523	248	53	12	7	--	--	--	--
Other softwoods	10,030	2,507	3,041	1,686	1,435	729	443	112	65	--	12	--	--
Total	78,025	26,211	18,066	13,783	9,069	5,787	3,037	1,115	413	191	121	213	19
Hardwoods													
Select white oak	62,163	24,463	9,349	8,556	5,150	4,304	2,868	2,174	1,843	1,349	808	1,106	193
Select red oak	58,187	25,012	7,698	7,954	3,633	3,334	3,040	2,779	1,798	1,084	716	1,042	97
Other red oak	31,918	12,991	4,241	4,298	2,809	2,165	1,745	1,233	1,195	531	334	332	44
Select hickory	19,387	9,490	2,946	1,886	1,340	1,429	955	684	365	171	52	68	1
Other hickory	17,155	8,452	3,214	1,740	1,194	944	839	394	201	120	39	18	--
Basswood	42,121	21,190	9,326	4,472	3,201	1,324	1,191	484	372	246	170	136	9
Beech	11,716	7,276	1,166	1,167	446	388	298	210	145	181	106	308	25
Yellow birch	6,004	3,224	1,675	413	315	143	110	59	35	6	7	17	--
Hard maple	78,601	51,884	12,192	6,139	2,440	2,047	1,314	710	717	512	256	347	43
Soft maple	224,129	118,776	46,819	22,629	13,071	8,545	5,439	3,501	2,129	1,281	783	1,020	136
Elm	188,144	108,846	45,579	18,825	7,703	4,376	1,677	677	320	94	29	18	--
Black ash	29,912	16,528	6,978	2,406	2,267	792	423	337	53	103	8	17	--
White and green ash	152,339	79,019	30,741	18,401	10,899	5,088	3,305	2,066	1,234	783	342	425	36
Sycamore	862	288	--	49	24	149	116	61	20	54	12	70	19
Cottonwood	8,986	1,402	1,598	1,874	869	667	683	567	482	343	152	254	95
Willow	4,678	1,572	896	697	455	348	218	135	149	54	54	77	23
Hackberry	2,609	1,018	844	535	112	49	12	11	9	19	--	--	--
Balsam poplar	1,173	402	120	254	139	88	38	71	15	17	5	24	--
Bigtooth aspen	22,412	6,882	4,062	3,627	2,814	2,446	1,348	902	243	69	7	12	--
Quaking aspen	47,271	20,973	8,860	9,455	4,534	2,255	693	283	119	88	6	5	--
Paper birch	9,640	4,080	2,169	1,233	1,529	352	216	22	32	--	7	--	--
Tupelo	3,199	1,434	703	821	153	20	13	38	--	--	--	17	--
Black cherry	103,931	65,494	14,957	10,614	5,244	3,520	1,790	1,189	473	366	156	121	7
Black walnut	7,810	2,214	1,137	1,552	965	796	502	307	153	103	47	34	--
Butternut	2,212	639	1,059	72	169	80	113	43	21	9	6	1	--
Yellow poplar	3,178	903	501	499	167	259	267	158	165	60	109	87	3
Sassafras	52,912	34,245	9,586	4,749	2,512	1,041	491	190	72	17	--	9	--
Other hardwoods	50,711	40,011	5,340	3,007	1,404	504	296	58	73	9	--	9	--
Total	1,243,360	668,708	233,756	137,924	75,558	47,453	30,000	19,343	12,433	7,669	4,211	5,574	731
All species	1,321,385	694,919	251,822	151,707	84,627	53,240	33,037	20,458	12,846	7,860	4,332	5,787	750

Table 12.--Net volume of growing-stock trees on timberland by species group and diameter class, Southern Lower Peninsula, Michigan, 1993

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height) 5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Jack pine	13,626	2,569	4,137	2,766	3,247	907	--	--	--	--	--
Red pine	85,014	10,712	18,975	21,597	19,340	9,257	4,003	1,130	--	--	--
White pine	103,684	6,986	10,977	17,876	14,568	9,224	7,258	7,405	6,438	18,774	4,178
White spruce	10,341	4,052	1,531	3,632	491	635	--	--	--	--	--
Balsam fir	424	--	--	424	--	--	--	--	--	--	--
Hemlock	12,026	631	663	378	623	2,266	780	738	1,100	3,752	1,095
Tamarack	13,303	1,832	4,532	2,154	2,441	2,065	--	279	--	--	--
Eastern redcedar	1,780	702	653	251	174	--	--	--	--	--	--
Northern white-cedar	8,800	3,086	2,285	2,084	897	220	228	--	--	--	--
Other softwoods	31,450	4,036	7,838	7,162	6,784	2,698	2,269	--	663	--	--
Total	280,448	34,606	51,591	58,324	48,565	27,272	14,538	9,552	8,201	22,526	5,273
Hardwoods											
Select white oak	462,788	20,345	28,239	41,345	43,942	48,541	57,018	56,499	43,090	90,284	33,485
Select red oak	448,603	18,272	19,868	34,635	49,150	66,824	59,603	48,415	41,410	92,700	17,726
Other red oak	207,595	10,108	15,019	21,558	26,457	27,610	36,062	21,688	17,722	25,180	6,191
Select hickory	90,988	4,573	7,757	14,481	15,874	17,569	13,064	8,319	3,010	6,099	242
Other hickory	62,893	3,842	6,848	9,745	14,950	9,958	7,392	6,239	2,331	1,588	--
Basswood	133,824	13,151	20,394	15,241	21,171	13,146	13,780	11,697	10,174	12,614	2,456
Beech	71,210	3,968	2,813	4,494	5,479	5,405	5,187	7,821	6,193	26,110	3,740
Yellow birch	10,641	1,159	1,851	1,448	1,707	1,556	1,169	241	328	1,182	--
Hard maple	208,604	18,086	16,869	24,551	24,608	19,292	26,320	25,135	15,941	30,497	7,305
Soft maple	739,213	64,561	85,926	97,147	98,388	91,154	76,747	59,790	46,255	91,341	27,904
Elm	194,057	45,450	42,551	46,128	26,949	15,964	10,162	3,942	1,618	1,293	--
Black ash	56,129	6,836	14,662	8,964	7,766	9,083	1,867	4,758	550	1,643	--
White and green ash	421,734	47,297	65,890	54,627	57,474	52,082	42,950	36,855	20,158	38,018	6,383
Sycamore	21,009	207	149	1,678	2,191	1,822	712	2,823	754	6,678	3,995
Cottonwood	112,706	3,213	4,214	6,606	10,778	12,393	15,444	14,274	8,035	22,155	15,594
Willow	34,364	1,601	2,345	3,238	3,190	3,101	4,390	2,162	2,879	7,189	4,269
Hackberry	4,628	1,647	788	492	177	342	354	828	--	--	--
Balsam poplar	8,922	755	807	1,081	793	1,789	509	793	343	2,052	--
Bigtooth aspen	122,350	11,441	19,822	29,242	24,116	24,205	8,919	3,238	422	945	--
Quaking aspen	106,147	24,977	28,016	24,468	12,004	7,339	4,194	4,291	419	439	--
Paper birch	23,866	4,114	9,853	4,084	3,857	562	1,010	--	386	--	--
Tupelo	5,062	2,098	804	190	209	805	--	--	--	956	--
Black cherry	238,060	32,784	37,874	43,409	35,112	33,543	17,652	17,863	9,658	9,268	897
Black walnut	53,596	4,332	6,747	9,015	9,361	8,433	5,431	4,600	2,868	2,809	--
Butternut	7,689	289	1,232	1,132	2,303	1,286	873	248	237	89	--
Yellow poplar	38,756	1,261	947	2,996	4,674	4,432	6,073	3,034	6,804	8,139	396
Sassafras	45,981	9,379	13,184	9,251	6,727	3,659	2,133	706	--	942	--
Other hardwoods	26,654	6,519	7,004	4,459	4,175	1,312	2,196	363	--	626	--
Total	3,958,069	362,265	462,473	515,705	513,582	483,207	421,211	346,622	241,585	480,836	130,583
All species	4,238,517	396,871	514,064	574,029	562,147	510,479	435,749	356,174	249,786	503,362	135,856

Table 13.--Net volume of growing-stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Southern Lower Peninsula, Michigan 1993

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	5,840	2,229	2,810	801	--	--	--	--	--
Red pine	50,272	18,986	17,857	8,637	3,737	1,055	--	--	--
White pine	72,255	13,823	12,159	7,910	6,278	6,417	5,601	16,384	3,683
White spruce	4,120	3,094	443	583	--	--	--	--	--
Balsam fir	357	357	--	--	--	--	--	--	--
Hemlock	9,513	314	546	2,005	697	651	977	3,341	982
Tamarack	6,175	1,838	2,200	1,882	--	255	--	--	--
Eastern redcedar	359	203	156	--	--	--	--	--	--
Northern white-cedar	2,852	1,667	785	197	203	--	--	--	--
Other softwoods	16,735	5,829	5,883	2,398	2,030	--	595	--	--
Total	168,478	48,340	42,839	24,413	12,945	8,378	7,173	19,725	4,665
Hardwoods									
Select white oak	275,305	--	27,931	34,427	42,019	42,399	32,733	69,513	26,283
Select red oak	276,777	--	31,428	47,578	44,181	36,555	31,572	71,479	13,984
Other red oak	117,931	--	16,909	19,618	26,845	16,494	13,591	19,593	4,881
Select hickory	42,863	--	9,032	11,667	9,157	5,989	2,225	4,599	194
Other hickory	27,854	--	8,688	6,580	5,185	4,483	1,719	1,199	--
Basswood	62,799	--	14,004	9,667	10,425	9,007	7,872	9,856	1,968
Beech	47,362	--	3,747	4,038	4,057	6,231	4,984	21,226	3,079
Yellow birch	4,622	--	1,125	1,173	911	191	262	960	--
Hard maple	109,765	--	15,750	13,822	19,578	19,075	12,201	23,594	5,745
Soft maple	354,353	--	61,559	63,927	56,399	44,784	35,137	70,513	22,034
Elm	39,262	--	16,128	10,842	7,242	2,878	1,199	973	--
Black ash	18,980	--	5,273	6,820	1,436	3,716	430	1,305	--
White and green ash	186,960	--	38,234	37,950	32,409	28,157	15,550	29,619	5,041
Sycamore	14,877	--	1,495	1,378	559	2,229	602	5,360	3,254
Cottonwood	70,144	--	6,233	8,062	10,769	10,281	5,904	16,725	12,170
Willow	19,391	--	1,824	2,040	3,063	1,545	2,116	5,449	3,354
Hackberry	1,207	--	105	239	254	609	--	--	--
Balsam poplar	4,684	--	553	1,294	385	607	262	1,583	--
Bigtooth aspen	44,794	--	16,306	18,058	6,834	2,516	330	750	--
Quaking aspen	20,670	--	8,081	5,403	3,208	3,313	323	342	--
Paper birch	3,918	--	2,489	394	744	--	291	--	--
Tupelo	1,506	--	148	581	--	--	--	777	--
Black cherry	88,051	--	22,527	23,785	13,035	13,484	7,355	7,152	713
Black walnut	24,989	--	6,366	6,316	4,206	3,612	2,248	2,241	--
Butternut	3,674	--	1,571	963	675	201	194	70	--
Yellow poplar	25,580	--	3,145	3,295	4,651	2,366	5,346	6,460	317
Sassafras	9,989	--	4,418	2,671	1,619	541	--	740	--
Other hardwoods	6,209	--	2,803	974	1,664	278	--	490	--
Total	1,904,516	--	327,872	343,562	311,510	261,541	184,446	372,568	103,017
All species	2,072,994	48,340	370,711	367,975	324,455	269,919	191,619	392,293	107,682

Table 14.--Net volume of sawtimber trees on timberland by species group and diameter class, Southern Lower Peninsula, Michigan, 1993

(In thousand board feet)[1]

Species group	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	33,556	13,125	15,856	4,575	--	--	--	--	--
Red pine	285,654	108,865	99,483	49,187	21,805	6,344	--	--	--
White pine	437,179	80,908	68,171	45,210	37,203	39,015	35,101	106,262	25,309
White spruce	24,342	18,400	2,540	3,402	--	--	--	--	--
Balsam fir	2,003	2,003	--	--	--	--	--	--	--
Hemlock	59,598	1,740	2,970	11,406	4,098	4,016	6,179	22,272	6,917
Tamarack	35,871	10,650	12,634	10,994	--	1,593	--	--	--
Eastern redcedar	2,211	1,279	932	--	--	--	--	--	--
Northern white-cedar	17,308	10,384	4,545	1,157	1,222	--	--	--	--
Other softwoods	96,372	33,808	33,020	13,782	12,039	--	3,723	--	--
Total	994,094	281,162	240,121	139,713	76,367	50,968	45,003	128,534	32,226
Hardwoods									
Select white oak	1,747,301	--	175,556	209,968	257,602	263,949	207,218	453,766	179,242
Select red oak	1,749,079	--	196,685	289,618	271,050	227,994	200,375	467,836	95,521
Other red oak	740,840	--	106,792	119,791	164,788	102,853	86,135	127,451	33,030
Select hickory	268,263	--	57,797	71,368	56,283	37,400	14,097	29,991	1,327
Other hickory	173,800	--	54,932	40,289	31,879	28,011	10,883	7,806	--
Basswood	396,138	--	87,785	59,266	64,407	56,488	50,069	64,486	13,637
Beech	307,417	--	24,145	25,372	25,570	39,604	32,133	139,758	20,835
Yellow birch	29,342	--	7,258	7,279	5,690	1,202	1,663	6,250	--
Hard maple	699,734	--	100,081	85,729	121,989	120,486	78,080	154,391	38,978
Soft maple	2,264,188	--	393,282	397,085	351,847	282,624	224,881	463,357	151,112
Elm	248,094	--	103,986	67,221	44,895	18,033	7,641	6,318	--
Black ash	118,519	--	33,047	41,919	8,883	23,323	2,763	8,584	--
White and green ash	1,164,386	--	234,719	229,298	198,272	175,464	98,620	193,633	34,380
Sycamore	97,233	--	9,390	8,526	3,494	14,176	3,873	35,416	22,358
Cottonwood	447,716	--	39,616	49,284	65,858	63,724	37,178	109,156	82,900
Willow	124,439	--	11,733	12,482	18,712	9,560	13,327	35,741	22,884
Hackberry	7,544	--	680	1,472	1,582	3,810	--	--	--
Balsam poplar	29,464	--	3,392	7,902	2,377	3,806	1,676	10,311	--
Bigtooth aspen	276,641	--	101,482	110,312	42,114	15,753	2,099	4,881	--
Quaking aspen	128,374	--	50,434	33,002	19,820	20,807	2,066	2,245	--
Paper birch	24,655	--	15,744	2,432	4,626	--	1,853	--	--
Tupelo	9,385	--	911	3,511	--	--	--	4,963	--
Black cherry	554,057	--	143,035	147,417	81,036	84,794	46,867	46,149	4,759
Black walnut	157,291	--	40,399	39,126	26,179	22,682	14,321	14,584	--
Butternut	22,990	--	9,895	5,952	4,218	1,251	1,219	455	--
Yellow-poplar	162,735	--	19,716	20,229	28,842	14,943	34,267	42,586	2,152
Sassafras	62,292	--	27,855	16,271	9,897	3,369	--	4,900	--
Other hardwoods	38,507	--	17,519	5,914	10,168	1,727	--	3,179	--
Total	12,050,424	--	2,067,866	2,108,035	1,922,078	1,637,833	1,173,304	2,438,193	703,115
All species	13,044,518	281,162	2,307,987	2,247,748	1,998,445	1,688,801	1,218,307	2,566,727	735,341

Table 15.--Net volume of growing-stock and sawtimber on timberland by county and species group, Southern Lower Peninsula, Michigan, 1993

County	Growing-stock					Sawtimber				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Allegan	288,457	24,446	1,384	98,268	164,359	917,234	80,687	6,917	294,036	535,594
Barry	188,908	8,255	3,477	68,076	109,100	615,875	28,180	9,239	179,093	399,363
Berrien	140,413	3,784	544	75,391	60,694	480,144	8,510	3,035	248,863	219,736
Branch	88,461	211	174	57,418	30,658	281,880	--	932	183,744	97,204
Calhoun	166,146	2,410	--	93,764	69,972	506,899	10,850	--	217,753	278,296
Cass	133,519	945	406	64,078	68,090	447,233	3,077	2,064	202,384	239,708
Clinton	58,400	--	--	40,966	17,434	141,197	--	--	104,660	36,537
Eaton	116,019	975	--	59,975	55,069	306,002	2,585	--	158,091	145,326
Genesee	74,295	--	--	29,745	44,550	235,007	--	--	79,746	155,261
Gratiot	71,764	3,064	--	34,662	34,038	211,308	8,471	--	98,445	104,392
Hillsdale	81,904	8,382	170	26,760	46,592	249,331	26,321	--	64,468	158,542
Huron	77,426	--	866	59,341	17,219	212,598	--	--	161,239	51,359
Ingham	79,607	513	855	39,340	38,899	245,674	2,407	4,455	117,640	121,172
Ionia	91,406	1,660	3,536	40,766	45,444	253,950	5,036	2,732	82,920	163,262
Jackson	122,578	2,275	165	36,967	83,171	401,392	5,563	--	94,365	301,464
Kalamazoo	115,629	19,144	1,271	58,836	36,378	360,820	73,469	3,234	184,457	99,660
Kent	211,556	13,079	250	86,884	111,343	639,038	58,874	--	217,632	362,532
Lapeer	120,494	16,253	3,544	50,895	49,802	341,043	33,617	14,375	127,632	165,419
Lenawee	94,475	--	1,515	42,076	50,884	274,333	--	1,787	102,078	170,468
Livingston	139,327	11,968	--	47,905	79,454	484,771	46,317	--	134,005	304,449
Macomb	52,108	--	2,763	27,568	21,777	155,569	--	6,210	70,925	78,434
Monroe	66,164	--	--	20,533	45,631	210,369	--	--	73,214	137,155
Montcalm	186,282	24,505	6,087	75,612	80,078	550,012	93,965	20,111	188,700	247,236
Muskegon	227,741	42,569	5,071	68,731	111,370	732,150	170,644	25,478	206,092	329,936
Oakland	127,158	1,514	293	48,586	76,765	383,490	7,083	--	101,011	275,396
Ottawa	112,721	18,815	2,547	42,189	49,170	365,020	58,271	11,212	113,269	182,268
Saginaw	114,969	7,045	--	50,639	57,285	315,243	27,096	--	99,972	188,175
St. Clair	160,466	10,226	1,548	58,376	90,316	499,312	54,597	6,535	170,531	267,649
St. Joseph	103,799	1,051	3,609	43,627	55,512	331,433	4,319	4,733	116,889	205,492
Sanilac	69,122	1,081	804	47,569	19,668	146,959	2,522	2,412	89,018	53,007
Shiawassee	92,292	--	--	42,391	49,901	326,005	--	--	140,275	185,730
Tuscola	127,122	1,761	4,368	84,124	36,869	314,733	6,982	9,396	188,520	109,835
Van Buren	163,593	7,754	--	71,490	84,349	497,213	32,818	--	172,410	291,985
Washtenaw	122,168	--	1,516	30,378	90,274	442,787	--	6,976	74,511	361,300
Wayne	52,028	--	--	22,856	29,172	168,494	--	--	53,584	114,910
All counties	4,238,517	233,685	46,763	1,846,782	2,111,287	13,044,518	852,261	141,833	4,912,172	7,138,252

[1] International 1/4-inch rule.

Table 16.--Net volume of timber on timberland by class of timber and major species group, Southern Lower Peninsula, Michigan, 1993

(In thousand cubic feet)

Class of timber	All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Live trees					
Growing-stock trees					
Sawtimber					
Saw log portion	2,072,994	145,022	23,456	773,890	1,130,626
Upper stem portion	738,883	22,433	3,340	302,027	411,083
Total	2,811,877	167,455	26,796	1,075,917	1,541,709
Poletimber	1,426,640	66,230	19,967	770,865	569,578
All growing-stock trees	4,238,517	233,685	46,763	1,846,782	2,111,287
Cull trees					
Short-log trees	125,629	3,337	682	54,912	66,698
Rough trees					
Sawtimber	136,003	9,401	1,248	62,460	62,894
Poletimber	142,297	6,812	1,126	65,093	69,266
Total	278,300	16,213	2,374	127,553	132,160
Rotten trees					
Sawtimber	37,487	546	584	20,702	15,655
Poletimber	8,514	14	70	5,584	2,846
Total	46,001	560	654	26,286	18,501
All cull trees	449,930	20,110	3,710	208,751	217,359
All live trees	4,688,447	253,795	50,473	2,055,533	2,328,646
Salvable dead trees					
Sawtimber	18,295	1,908	--	6,883	9,504
Poletimber	18,116	906	263	12,244	4,703
Total	36,411	2,814	263	19,127	14,207
All classes	4,724,858	256,609	50,736	2,074,660	2,342,853

Table 17.--Net volume of live and growing-stock trees on timberland by ownership class and major species group, Southern Lower Peninsula, Michigan, 1993

(In thousand cubic feet)

Ownership class	Live trees					Growing-stock trees				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	19,656	6,403	--	2,421	10,832	16,949	5,805	--	2,124	9,020
State	415,085	64,790	4,503	134,008	211,784	385,473	61,897	4,383	121,531	197,662
County and municipal	139,651	16,754	5,535	48,046	69,316	129,187	16,075	5,535	43,446	64,131
Misc. private-corporation	384,375	6,236	4,415	152,306	221,418	348,707	5,518	4,255	136,869	202,065
Misc. private-individual/farmer	3,729,680	159,612	36,020	1,718,752	1,815,296	3,358,201	144,390	32,590	1,542,812	1,638,409
All owners	4,688,447	253,795	50,473	2,055,533	2,328,646	4,238,517	233,685	46,763	1,846,782	2,111,287

Table 18.--Average annual net growth of growing stock and sawtimber on timberland by county and major species group, Southern Lower Peninsula, Michigan, 1980-1992

County	Growing stock					Sawtimber				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Allegan	9,062	812	46	3,568	4,638	34,987	4,188	193	12,739	17,867
Barry	5,860	340	245	2,381	2,894	23,728	1,759	791	6,963	14,215
Berrien	4,683	290	12	2,520	1,861	18,462	650	77	9,335	8,400
Branch	2,510	17	1	1,635	857	9,601	--	5	6,755	2,841
Calhoun	5,805	143	--	3,624	2,038	21,138	688	--	12,529	7,921
Cass	3,338	-10	10	1,577	1,761	12,779	251	57	5,715	6,756
Clinton	2,068	--	--	1,433	635	7,152	--	--	6,020	1,132
Eaton	4,794	50	--	2,331	2,413	13,770	218	--	6,413	7,139
Genesee	2,681	--	--	1,282	1,399	9,097	--	--	3,364	5,733
Gratiot	2,511	134	--	1,229	1,148	10,065	359	--	5,097	4,609
Hillsdale	4,402	741	8	1,508	2,145	15,108	3,896	--	3,718	7,494
Huron	3,044	--	55	2,217	772	11,829	--	--	8,737	3,092
Ingham	3,152	52	53	1,690	1,357	11,567	116	374	5,636	5,441
Ionia	3,926	133	367	1,887	1,539	10,728	845	241	3,501	6,141
Jackson	3,722	152	36	1,357	2,177	14,420	434	--	3,772	10,214
Kalamazoo	4,109	606	86	2,078	1,339	11,994	2,633	254	5,934	3,173
Kent	7,561	678	51	2,936	3,896	27,008	3,286	--	8,703	15,019
Lapeer	5,922	971	588	2,716	1,647	18,811	2,449	1,019	8,906	6,437
Lenawee	2,840	--	22	1,505	1,313	9,498	--	22	4,121	5,355
Livingston	4,884	497	--	2,148	2,239	17,880	2,488	--	6,680	8,712
Macomb	1,968	--	92	1,106	770	5,096	--	115	2,776	2,205
Monroe	2,045	--	--	677	1,368	7,041	--	--	2,713	4,328
Montcalm	6,502	974	5	2,780	2,743	23,400	4,649	631	7,731	10,389
Muskegon	6,893	1,666	121	2,133	2,973	27,304	6,835	960	6,902	12,607
Oakland	4,809	74	73	2,362	2,300	14,090	390	--	4,701	8,999
Ottawa	3,929	690	70	1,770	1,399	14,236	2,363	411	4,513	6,949
Saginaw	4,116	357	--	1,998	1,761	12,224	1,441	--	4,947	5,836
St. Clair	5,074	227	61	1,876	2,910	17,365	1,339	224	6,182	9,620
St. Joseph	3,227	70	254	1,428	1,475	11,785	261	395	4,163	6,966
Sanilac	3,037	138	58	1,971	870	7,495	212	480	3,610	3,193
Shiawassee	3,105	--	--	1,567	1,538	12,746	--	--	5,426	7,320
Tuscola	5,708	145	75	3,670	1,818	14,865	173	527	9,319	4,846
Van Buren	5,505	278	--	2,831	2,396	19,654	1,673	--	7,722	10,259
Washtenaw	3,321	--	53	1,210	2,058	12,832	--	315	3,516	9,001
Wayne	2,007	--	--	1,025	982	6,625	--	--	2,781	3,844
All counties	148,120	10,225	2,442	70,026	65,427	516,380	43,596	7,091	211,640	254,053

[1]International 1/4-inch rule.

Table 19.--Average annual removals of growing stock and sawtimber on timberland by county and major species group, Southern Lower Peninsula, Michigan, 1980-1992

County	Growing-stock					Sawtimber				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Allegan	2,377	1,482	--	323	572	9,598	6,547	--	1,265	1,786
Barry-Eaton	3,164	71	--	778	2,315	12,209	393	--	2,016	9,800
East Central Group[2]	2,731	--	--	1,347	1,384	9,232	--	--	4,359	4,873
Huron-Sanilac-Tuscola	2,644	--	--	1,621	1,023	6,714	--	--	3,432	3,282
Ingham-Livingston	2,859	--	--	1,317	1,542	10,027	--	--	4,254	5,773
Ionia-Kent-Ottawa	2,755	436	--	745	1,574	8,690	498	--	2,363	5,829
Montcalm	3,898	74	22	1,880	1,922	12,165	398	--	5,690	6,077
Muskegon	3,689	2,429	--	676	584	12,091	8,368	--	1,505	2,218
Northern Group[3]	3,847	--	--	1,676	2,171	14,984	--	--	6,706	8,278
Southeastern Group[4]	3,006	--	--	1,130	1,876	11,224	--	--	3,519	7,705
Southwestern Group[5]	2,393	--	--	1,496	897	9,099	--	--	5,232	3,867
All counties	33,363	4,492	22	12,989	15,860	116,033	16,204	--	40,341	59,488

[1] International 1/4-inch rule.

[2] East Central Group includes Genesee, Lapeer, Macomb, Oakland, and St. Clair Counties.

[3] Northern Group includes Clinton, Gratiot, Saginaw, and Shiawassee Counties.

[4] Southeastern Group includes Hillsdale, Jackson, Lenawee, Monroe, Washtenaw, and Wayne Counties.

[5] Southwestern Group includes Berrien, Branch, Calhoun, Cass, Kalamazoo, St. Joseph, and Van Buren Counties.

Table 20.--Average annual net growth, average annual mortality, and average annual removals of growing stock and sawtimber on timberland by species group, Southern Lower Peninsula, Michigan, 1980-1992

Species group	Growing stock			Sawtimber		
	Net growth [1]	Mortality	Removals	New growth [1]	Mortality	Removals
	Thousand cubic feet			*Thousand board feet* [2]		
Softwoods						
Jack pine	67	353	59	545	1,078	--
Red pine	4,290	--	2,447	17,034	5	8,124
White pine	4,331	417	1,572	20,121	1,429	7,582
White spruce	1,216	--	--	2,619	4	--
Balsam fir	11	--	--	55	--	--
Hemlock	278	23	--	1,534	7	--
Tamarack	387	326	--	1,639	340	--
Eastern redcedar	165	--	--	110	--	--
Northern white-cedar	333	36	22	1,092	138	--
Other softwoods	1,589	108	414	5,938	18	498
Total	12,667	1,263	4,514	50,687	3,019	16,204
Hardwoods						
Select white oak	9,924	542	3,001	48,889	1,868	11,900
Select red oak	13,192	1,572	4,253	60,596	4,104	18,228
Other red oak	5,996	819	2,123	25,844	2,183	9,124
Select hickory	1,918	444	324	7,119	1,376	1,032
Other hickory	1,613	277	272	6,582	789	951
Basswood	3,834	678	1,312	13,072	2,240	4,116
Beech	1,808	141	792	9,051	537	2,738
Yellow birch	135	206	--	737	469	--
Hard maple	6,572	273	1,505	21,609	1,177	6,291
Soft maple	26,571	2,145	4,002	89,830	6,536	15,306
Elm	12,069	4,498	882	22,172	6,175	615
Black ash	1,694	405	309	3,584	905	316
White and green ash	18,752	1,525	2,915	60,182	3,483	8,616
Sycamore	412	26	133	2,491	44	732
Cottonwood	4,738	195	1,141	22,273	553	5,135
Willow	590	334	159	3,075	981	512
Hackberry	173	12	--	301	6	--
Balsam poplar	230	194	314	1,439	528	689
Bigtooth aspen	4,159	1,650	1,378	15,222	4,207	4,570
Quaking aspen	4,726	2,228	1,714	8,397	1,958	3,376
Paper birch	489	406	84	762	494	--
Tupelo	253	7	19	649	7	78
Black cherry	8,552	861	1,317	21,317	845	3,789
Black walnut	1,743	181	76	6,391	737	387
Butternut	204	36	--	1,020	4	--
Yellow poplar	1,332	63	225	6,036	146	1,107
Sassafras	2,006	359	408	4,001	391	107
Other hardwoods	1,768	146	191	3,052	41	114
Total	135,453	20,223	28,849	465,693	42,784	99,829
All species	148,120	21,486	33,363	516,380	45,803	116,033

[1] An estimate of average gross growth may be computed by adding average mortality to average net growth.
[2] International 1/4-inch rule.

Table 21.--Average annual net growth and average annual removals of growing stock on timberland by ownership class and major species group, Southern Lower Peninsula, Michigan, 1980-1992

(In thousand cubic feet)

Ownership class	Growth					Removals				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	333	132	--	30	171	156	--	--	--	156
State	13,430	2,422	46	5,518	5,444	2,722	1,669	22	781	250
County and municipal	3,991	654	119	1,376	1,842	2,136	942	--	1,010	184
Misc. private-corporation	12,097	299	280	5,022	6,496	1,880	--	--	863	1,017
Misc. private-individual/farmer	118,269	6,718	1,997	58,080	51,474	26,469	1,881	--	10,335	14,253
All owners	148,120	10,225	2,442	70,026	65,427	33,363	4,492	22	12,989	15,860

Table 22.--Average annual net growth and average annual removals of sawtimber on timberland by ownership class and major species group, Southern Lower Peninsula, Michigan, 1980-1992

(In thousand board feet) [1]

Ownership class	Growth					Removals				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	1,569	175	--	134	1,260	366	--	--	--	366
State	44,818	10,983	507	13,392	19,936	8,500	7,235	--	267	998
County and municipal	17,699	3,097	1,049	6,463	7,090	4,898	1,924	--	2,317	657
Misc. private-corporation	38,752	1,352	1,164	13,026	23,210	6,547	--	--	3,057	3,490
Misc. private-individual/farmer	413,542	27,989	4,371	178,625	202,557	95,722	7,045	--	34,700	53,977
All owners	516,380	43,596	7,091	211,640	254,053	116,033	16,204	--	40,341	59,488

[1] International 1/4-inch rule.

Table 23.--Current annual net growth, current annual mortality, and 1990 removals of growing stock and sawtimber on timberland by species group, Southern Lower Peninsula, Michigan, 1992

Species group	Growing stock			Sawtimber		
	1992 Net Growth [1]	1992 Mortality	1990 Removals [2]	1992 Net Growth [1]	1992 Mortality	1990 Removals [2]
	----- *Thousand cubic feet* -----			----- *Thousand board feet* [3] -----		
Softwoods						
Jack pine	88	491	--	-64	1,241	1
Red pine	4,340	2	647	19,978	59	3,653
White pine	5,192	207	44	23,187	645	256
White spruce	1,610	9	--	3,035	22	2
Balsam fir	-3	11	--	-13	51	*
Hemlock	414	14	--	2,339	63	--
Tamarack	432	91	--	2,756	203	--
Eastern redcedar	210	3	--	128	1	--
Northern white-cedar	403	--	--	738	18	2
Other softwoods	1,922	17	--	7,136	54	--
Total	14,608	845	691	59,220	2,357	3,914
Hardwoods						
Select white oak	11,378	81	2,839	53,263	892	11,305
Select red oak	12,203	2,093	7,135	57,710	5,350	33,588
Other red oak	5,486	1,214	--	26,112	3,210	--
Select hickory	2,033	354	392	7,976	1,034	2225
Other hickory	1,593	241	--	5,568	576	--
Basswood	3,697	731	453	10,009	2,201	2,367
Beech	1,814	183	245	9,259	694	1,337
Yellow birch	360	85	1	848	214	21
Hard maple	6,366	479	925	20,574	1,338	5,240
Soft maple	26,987	2,688	2,912	80,822	7,675	13,086
Elm	14,580	3,406	112	33,313	6,279	621
Black ash	1,881	322	1,426	3,191	812	7,315
White and green ash	21,977	1,360	**	69,222	2,355	**
Sycamore	536	64	--	2,899	294	--
Cottonwood	4,106	418	465	20,458	1,638	2,413
Willow	898	129	--	2,959	395	--
Hackberry	120	24	--	186	27	--
Balsam poplar	358	156	19	2,091	486	101
Bigtooth aspen	4,915	1,571	1,590	21,352	3,633	4,953
Quaking aspen	4,900	2,090	***	12,412	2,142	***
Paper birch	789	170	26	1,310	242	131
Tupelo	270	30	--	564	52	--
Black cherry	8,122	799	--	24,970	1,289	--
Black walnut	1,551	148	--	6,127	375	--
Butternut	272	21	--	1,796	56	--
Yellow-poplar	1,086	92	--	4,855	347	--
Sassafras	2,345	516	--	4,575	573	--
Other hardwoods	1,714	251	1,093	3,098	331	5,547
Total	142,337	19,716	19,633	487,519	44,510	90,250
All species	156,945	20,561	20,324	546,739	46,867	94,164

[1] An estimate of current gross growth may be computed by adding current mortality to current net growth.

[2] Based on mill survey data (Hackett and Pilon 1993). For the Southern Lower Peninsula, 1990 is the most current mill survey.

[3] International 1/4 inch rule.

* Removals for the black spruce species group are included in the removals for white spruce.

** Removals for the white and green ash species group are included in the removals for black ash.

*** Removals for the quaking aspen species group are included in the removals for bigtooth aspen.

Table 24.--Net volume of sawtimber trees on timberland by species group and butt log grade or tree grade, Southern Lower Peninsula, Michigan, 1993

(In thousand board feet)[1]

Species	All grades	Butt log grade			
		1	2	3	Tie and timber
Softwoods					
Jack pine	33,556	--	--	33,556	--
Red pine	285,654	--	--	285,654	--
White pine	437,179	25,364	20,484	330,786	60,545
White spruce	24,342	--	--	24,342	--
Balsam fir	2,003	--	--	2,003	--
Hemlock	59,598	--	8,675	50,923	--
Tamarack	35,871	--	22,577	13,294	--
Eastern redcedar	2,211	--	--	2,211	--
Northern white-cedar	17,308	--	--	17,308	--
Other softwoods	96,372	--	--	96,372	--
Total	994,094	25,364	51,736	856,449	60,545

Species	All grades	Tree grade			
		1	2	3	Tie and timber
Hardwoods					
Select white oak	1,747,301	325,170	569,874	655,557	196,701
Select red oak	1,749,079	398,618	462,392	533,336	354,733
Other red oak	740,840	129,416	225,124	229,676	156,625
Select hickory	268,263	20,896	69,277	140,307	37,784
Other hickory	173,800	36,197	35,436	63,606	38,560
Basswood	396,138	136,601	144,253	115,284	--
Beech	307,417	42,502	70,882	132,009	62,024
Yellow birch	29,342	--	3,892	20,711	4,739
Hard maple	699,734	303,208	177,106	171,030	48,389
Soft maple	2,264,188	158,004	612,550	1,033,176	460,457
Elm	248,094	11,799	49,029	163,200	24,066
Black ash	118,519	--	51,290	63,359	3,870
White and green ash	1,164,386	307,010	417,129	356,020	84,227
Sycamore	97,233	24,235	34,779	38,218	--
Cottonwood	447,716	93,142	101,562	201,283	51,729
Willow	124,439	5,020	45,854	48,051	25,514
Hackberry	7,544	4,416	--	3,128	--
Black poplar	29,464	6,734	3,970	15,105	3,655
Bigtooth aspen	276,641	--	45,743	127,472	103,426
Quaking aspen	128,374	13,499	11,173	64,122	39,581
Paper birch	24,655	--	--	24,655	--
Tupelo	9,385	--	--	9,385	--
Black cherry	554,057	76,641	167,670	283,033	26,714
Black walnut	157,291	31,645	71,144	49,118	5,384
Butternut	22,990	--	19,167	3,823	--
Yellow poplar	162,735	57,285	32,572	63,203	9,676
Sassafras	62,292	8,705	12,184	41,404	--
Other hardwoods	38,507	--	6,886	19,771	11,850
Total	12,050,424	2,190,744	3,440,937	4,669,041	1,749,702
All species	13,044,518	2,216,108	3,492,673	5,525,490	1,810,247

[1]International 1/4-inch rule.

Table 25.--Comparison of adjusted 1980 and 1993 area and growing-stock volume by forest type, Southern Lower Peninsula, Michigan

Forest type	Area 1980	Area 1993	Change in area amount	Percent change in area 1980-93	Growing-stock volume 1980	Growing-stock volume / acre 1980	Growing-stock volume 1993	Growing-stock volume / acre 1993	Change in amount of volume	Percent change growing-stock 1980-93
	(thousand acres)	*(thousand acres)*	*(thousand acres)*	*(%)*	*(thousand cubic feet)*	*(cubic feet per acre)*	*(thousand cubic feet)*	*(cubic feet per acre)*	*(thousand cubic feet)*	*(%)*
Jack pine	43.4	42.1	-1.3	-3	32,584	751	46,771	1,111	14,187	44
Red pine	34.9	50.5	15.6	45	48,387	1,386	91,428	1,810	43,041	89
White pine	14.6	23.6	9.0	62	33,975	2,327	29,534	1,251	-441	-13
Balsam fir	--	--	--	--	--	--	--	--	--	--
White spruce	2.6	8.6	6.0	231	1,561	600	6,650	773	5,089	326
Black spruce	--	--	--	--	--	--	--	--	--	--
Northern white-cedar	13.0	6.0	-7.0	-54	4,234	326	5,337	890	1,103	26
Tamarack	4.4	7.8	3.4	77	1,096	249	4,724	606	3,628	331
Oak-hickory	673.5	746.4	72.9	11	891,732	1,324	1,298,151	1,739	406,419	46
Elm-ash-soft maple	549.5	665.1	115.6	21	492,698	897	870,292	1,309	377,594	77
Maple-birch	930.6	1,300.9	370.3	40	946,694	1,017	1,759,076	1,352	812,382	86
Aspen	181.5	121.2	-60.3	-33	132,052	728	121,301	1,001	-10,751	-8
Paper birch	6.6	7.0	.4	6	4,409	668	289	41	-4,120	-93
Balsam poplar	6.6	6.9	.3	5	3,039	460	4,331	628	1,292	43
Nonstocked	15.3	14.6	-.7	-5	--	--	633	43	633	--
Total/ average	2,476.5	3,000.7	524.2	21	2,592,461	1,047	4,238,517	1,413	1,646,056	63

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The fifth inventory of Michigan's Southern Lower Peninsula forests reports 14,429.0 thousand acres of land, of which 3,053.7 thousand acres are forested. This bulletin presents statistical highlights and contains detailed tables of forest area, as well as timber volume, growth, removals, mortality, and ownership.

KEY WORDS: Forest area, timber volume, growth, removals, mortality.

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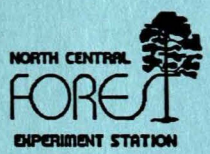
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